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7 September - 11 September, 1993

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FOREWORD

Processing and preservation of food and agricultural products have an important role to play in transforming the predominantly agricultural economics of many of the developing countries into mixed agro-industrial economics. Through proper development, they can contribute significantly in increasing the share of developing countries from the present 3% in world industrial production to 35% by the year 2010. This, in turn, will stimulate food production, prevent post-harvest losses during conservation, handling, processing and marketing. Development of the processing infra-structure will further contribute to additional employment opportunities, raising the level of investments, boosting incomes especially in rural areas and increasing the export of new value-added finished products.

In highly industrialised countries of the world, 80-85% of the food raw materials undergo high degree of processing before reaching the consumer. In contrast, technologically under-developed countries are able to process only 10-12% of the raw materials as reflected by the low per capita consumption of processed foods varying from US $10 to 100 per year.

It is in the above context that Association of Food Scientists and Technologists (India) and Central Food Technological Research Institute, have taken steps to organise the Third International Food Convention (IFCON-93) at Mysore during 7-12 September 1993, bringing together various partners in food industry development such as food producers, processors, distributors, scientists, technologists, engineers, government agencies, policy makers and national and international agencies.

The convention aims at the following (a) examine the state-of-the-art in the area of Food Science and Technology through consultation, discussion and interaction amongst peers and scientific workers engaged in R&D and training in various aspects of food processing, (b) explore establishment of cooperative and collaborative efforts to spread the fruits of R&D universally, (c) highlight technological opportunities for setting up agro-food processing industries and hence exploitation of the resources more optimally, (d) provide impetus to international trade in value-added food products through upgradation of technology and confidence generation amongst buyers, (e) expand the horizons of human resources development to meet the increasing and specialised demands for trained personnel for the food processing industry, (f) contribute to the process of policy making at National and International levels that will aid the strengthening and growth of food processing industry, and (g) facilitate the ongoing endeavours at National and International levels for consumers safety and welfare through better and safe food products.

The Convention will have General Sessions and parallel Technical Sessions as well as Poster Sessions. The General Sessions will cover subjects on Policy issues, R&D management, Technology Transfer, Agro Development, Emerging technologies, Traditional foods, Food quality, Human nutrition, Convenience and speciality foods, Food engineering, Biotechnology, Street foods and Food safety and Standards, Human resource development, etc. These general sessions will draw upon the rich experience of leading scientists and technologists. Parallel scientific and technical sessions will focus on Foodgrains, Animal products, Edible oils, Horticultural processing, Dairy products, Plantation products, Marine products and product mixes based on them both Traditional and Non-traditional, Flavour technology, Food adjuncts

and additives, etc. Poster sessions will be arranged in specific dates to cover all contributed papers based on original works.

As a curtain raiser to this Convention, the organisers thought it fit to bring out this publication which includes a lead article on "Food Technology Update" by Dr. V.H. Potty, and the abstracts of 140 invited papers. We are highly thankful to Dr. V.H. Potty for the lead article. AFST(I) is greatly indebted to Technical Committee headed by Sri C.P. Natarajan and assisted by Dr. S. Ranganna for the commendable job done in identifying the topics, collecting and collating the abstracts of invited papers and preparing the materials ready for printing.

Our thanks are also due to Sri K.A. Ranganath and Mrs. Darley Thomas for coordinating the production of this publication and Mr. G.C.P. Rangarao for the cover page design and the staff of CFTRI Printing Press for the good job of transforming the manuscripts into a presentable form. We hope this publication will serve as an useful and reliable reference source material of technical information to all those interested in Food Science and Technology including the food processing industry. The Convention can be relied upon to evolve clear-cut policy orchestration of food industry development at Government and industry levels in the years to come. It is also expected to serve as a guide for prospective planning of Food Research and Development in the country.

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FOOD TECHNOLOGY UPDATE

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Food Technology covers a vast area of inter disciplinary subjects ranging from biochemistry, microbiology, biophysics, various branches of engineering to food quality and safety. Over ten thousand scientific personnel are reported to be involved in food research in different parts of the world covering different aspects. There are continuing efforts to evolve techniques and technologies that are consumer and nature friendly, low cost, of improved productivity, energy economic and capable of producing nature resembling products with undoubted safety features. Successes achieved in a few typical cases during the last five years have been culled out from international information sources under six distinct areas which include 1) New and improved technologies 2) New ingredients and product concepts 3) Process control and instrumentation 4) Food bio-technology 5) Consumer health and food safety and 6) Miscellaneous.

1. NEW AND IMPROVED TECHNOLOGIES

1.1 Athermal process for food preservation

Increased concerns regarding food safety and nature conservation are making the consumers look for minimally processed foods with least distortions to the profile of the food during processing. Reduced thermal inputs during processing and preservation steps are being suggested through new technologies. Several recent developments in the area of food technology suggest that industry can look forward to deployment of viable but acceptable process technologies in the coming years based on current progress achieved so far. These developments include utilisation of electric or magnetic fields, microwave radiation, light pulses, high isobaric pressure, chemical agents such as CO_2 and polycationic polymers and lytic enzymes.

High electric field pulses : This technology relies on the lethal effect of strong electric fields for the inactivation of microorganisms. As per the dielectric rupture theory, the external electric field induces an electric potential over the membrane which, in turn, causes a charge separation in the cell membrane. When the trans membrane potential exceeds about one volt, the repulsion between charge carrying molecules causes the formation of pores in the cell membrane. The critical trans membrane potential and consequently the external field strength depends on the type of biological cell, the cell diameter, shape and the growing conditions. This concept is industrially being applied in the elcrack system developed in Germany for fat recovery from comminuted fish and slaughter house

offals. By using high electric field pulses, the undesirable changes such as protein denaturation and vitamin destruction are avoided. Similarly, the Elasteril process uses strong electric fields to inactivate microorganisms in pumpable foods. Efforts so far have indicated that this technique is effective against only vegetative microorganisms while spores are not affected. Recent reports in USA have claimed high electric field pulses to be more effective when combined with pasteurisation temperatures which may even eliminate problems due to spore contamination in food. Dairy products, fruit juices, egg melange are some of the potential candidates.

Oscillating magnetic field pulses : Subjecting a plastic or glass packed food to one or more pulses of an oscillating magnetic field can lead to destruction of microbial cells. The oscillating magnetic field is claimed to couple energy into magneto-active parts of large biological molecules with several oscillations. When a large number of magnetic dipoles are present in one molecule, enough energy can be transferred to the molecule to break a covalent bond resulting in breaking of vital cell constituents like DNA, enzymes etc. leading ultimately to the destruction of the microorganisms or rendering it reproductively inactive. Microorganisms are inactivated when frequencies are in the 5-500 kHz range. As the exposure time is only for a few microseconds/milliseconds, no appreciable rise in temperature is caused. Helium-cooled coils can give magnetic field intensity between 5 and 50 tesla and the industry may have to wait for equipment that can use the above phenomenon on an industrial scale.

Microwave effects : It has been suggested that the lethal effect of microwave radiation is not solely due to the heating achieved and there are reports that low frequency electro magnetic fields can interact with individual cells and organs to produce biological change. However, it is a point for debate as to whether the thermal effect is not the over-riding factor responsible for the kill of microbes. The reported alternate use of microwave pulses and cooling to perform biochemical and chemical reactions is another possibility which will permit inactivation of microbes and enzymes at much higher reaction rates while limiting the increase in temperature of the treated material. Much more needs to be done to conclusively establish any non-thermal effect of microwave application in food.

Linear induction electron accelerator : The effect of ionizing radiation on biological cells is well known and its application in more than 50 types of foods has been cleared by the FAO/WHO since 1981. However, practical applications are restrained by the reservation on the part of the consumer and logistical problems associated with setting and operating gamma-irradiation facilities in food processing plants. Linear induction electron accelerator (LIEA) is an electrically driven source of ionising radiation which can overcome a number of hurdles associated with radio-nuclei such as Cobalt-60 and Caeseium-137. Just like the radio nuclides, the LIEA generates ionizing radiation capable of producing ions and excited molelcules inducing chemical changes in the food and in biological cells. These changes are responsible for inactivating pathogenic and

spoilage microorganism. The LIEA generates broad spectrum ionizing radiation by targeting the accelerated electron beam to collide with a heavy metal converter plate which converts the electron beam into X-rays with a broad band photon energy spectrum. Electrically driven radiation sources that can be switched off and on at will, is easier to be incorporated into existing food processing plants unlike the massive concrete structure required to house radiation sources. The practical application of food radiation in conjunction with existing food processing equipment is further facilitated by a) better control of the direction of the electrically produced radiation b) shaping the geometry of the radiation field to accommodate different package sizes and c) its high reproducibility and versatility. LIEA can deliver dose rates many orders of magnitude higher than possible with Co-60 sources.

Intense light pulses : Light pulses having a duration of 10^{-6} to 10^{-1} sec, an energy density of 0.01 - 50/cm^2 and a wave length spectrum between 170 and 2600 nm are reported to be effective in inactivating microorganisms on the surface of the food materials and within transparent bulk liquids, solids and gases. Depending on the selected application, particular spectral distributions and energy densities are chosen. UV-rich light pulses with at least 30% of the light energy at wave lengths shorter than 300 nm are considered effective for aseptic packaging materials and air, water and salt solutions. These UV-rich pulses inactivate microorganisms and viruses through a combined photo-thermal and photo-chemical mechanisms. In case of food products whose quality is susceptible to be affected adversely by the UV bandwidth, modifications can be done to filter out the UV from the source of light. Application of intense light pulses transfers large amounts of thermal energy to the surface of the material in order to raise a thin superficial layer to sufficiently high temperatures to inactivate surface microorganisms, enzymes and viruses, without critically raising the interior temperature of the food product. Use of absorption enhancing agents which can be applied to the surface of the foodstuff or packaging material is also a possibility.

Incoherent light pulses of sufficient intensity and appropriate duration and wavelength distribution can be obtained from pulsed, gas-filled flash lamps, typically employing inert gases like xenon or krypton. Besides packaging materials, this technique is considered suitable for the surface sterilisation of beef, pork, poultry, vegetables, fruits, fish, bakery goods, solid dairy products and bulk sterilisation of transparent fluids, free of solid particulates.

Carbon-dioxide treatments : Carbon dioxide has been proven to be effective in extending shelf-life of perishable foods by retarding bacterial growth. Most of the published data on bacterial growth in CO_2 atmosphere indicate a pH decrease of the growth medium. It is claimed that CO_2 when applied to a biological tissue first dissolves into the liquid phase of the tissue and then absorbed as carbonic acid in the undissociated form causing a pH drop. The rate of penetration of CO_2 in solution into the cell will determine its ultimate effectiveness. Metabolic

interference with certain enzyme systems also contributes to the effectiveness of CO_2.

Chitosan : Antimicrobial activity attributed to chitosan requires further exploration as very little development work has been reported till recently. However, according to the present thinking, chitosan's effectiveness could be due to its polycationic nature causing membrane disturbances. Beyond a certain levels chitosan may coat the microbial cell membrane due to which mass transfer to and from the microbial cells is affected.

Antimicrobial enzymes : These enzymes are effective in a number of ways. Some deprive the organisms of necessary metabolites while others generate substances toxic to the organisms. Some enzymes attack the cell wall component and physically disrupt the cell or change the permeability characteristics. A few enzymes are known to inactivate other enzymes, vital for the survival of the microorganisms. Lytic enzymes such as chitinase and gluconases, lysozymes, proteases, sulphydryl oxidase are a few examples of enzymes having proven antimicrobial activity that can be considered for designing non-thermal processing systems.

High pressure treatment : High osmotic pressures in the range of 500 to 10,000 bar at ambient temperature have been known to have lethal effect on microorganisms for a long time. However, it was only recently that this basic principle was made use of in setting up commercial units which are reported to be working satisfactorily in Japan. The ever increasing consumer demand for minimally processed foods with no additives has given fillip to investments on commercial development of high pressure sterilisation systems in some parts of the world. High pressure treatment is capable of enhancing the shelf-life of food products without destroying the nutrients. As the process is carried out at ambient temperature, covalent bonds are not disturbed. For more than 30 years, the technology was being used for the production of high performance ceramics, carbides and metals and for synthetic growing of quartz. Commercial high pressure treatment plants have been designed involving pressures ranging from 50 MPa, cycle times from 20 seconds upto several weeks, temperature from ambient to 2200°C, effective vessel volume of a few ml upto several m^3 and vessel cycle lives of a few thousand cycles upto an infinite cycle life. Though high pressure pasteurization of high acid foods like jam, fruit juices and fruit desserts is already applied commercially in Japan, the technology is not totally effective in destroying bacterial spores and inactivating many enzymes. Probably, development of combination of high pressure with moderate temperatures may have to be evolved if universal acceptance is desired. High pressure treatment combined with chilled storage and distribution may also be possible if quality deterioration by enzymes is to be prevented in the case of many products. Thus, this technology is conveniently suited to the food industry as it can be helpful in developing foods of high nutrition and sensory properties, novel texture, more

convenience and increased shelf-life. This technology is compatible with the existing range of semi-rigid and flexible packaging materials.

1.2. Ohmic Heating for Aseptic Products

The ohmic heating effect occurs when an electrical current is passed through an electrically conducting product. Low frequency alternating current from the public utility supply, combined with specially designed electrode system, is used to eliminate the possibility of adverse electro-chemical reactions. Generally, the product does not experience any large temperature gradient within itself as it heats and both liquid and particulates are heated virtually simultaneously resulting in less heat damage to the liquid phase and avoiding overcooking of solid phase. As there are no heat transfer surfaces, possibility of deposit formation and transfer of burnt particles to the finished products are avoided. Most food products contain moderate percentage of free water with dissolved ionic salts and hence conduct electric current sufficiently well for ohmic effect to be effective. Commercial ohmic heating-based plants are now available with fully automatic temperature control system.

The past decade has seen a significant growth in ready prepared food products available to consumers in many of the developed countries. Cook-chilling process and in-container sterilisation are acceptable technologies but with severe limitations of shelf stability and quality. A major alternative which has emerged during the last decade to the established conventional technologies is aseptic processing using plate, tubular or scraped surface heat exchangers followed by filling into paper board or plastic containers under aseptic conditions. Though this modern technology has been widely adopted by the food industry, the use of conventional heat transfer techniques necessitates over-processing of liquid phase to ensure that centre of each particulate is sterilised. This may result in destruction of flavours and nutrients and mechanical damage to the particulate. These heat transfer problems have been overcome with the use of ohmic heater systems in aseptic processing plants. Ohmic heating system is commercially in use in Europe, USA and Japan and ohmic heater assembly can be incorporated as a part of the aseptic plant to ensure high end product quality.

1.3. Microwave Wave Processing and Food Industry

Microwave processing in the food industry is not very much prevalent, though use of microwave ovens has become widespread in the household. It is estimated that not more than 500 food processing installations are utilising the microwave processing system all over the world. One of the major reasons for this clean technology not being able to make a breakthrough is related to its costs. By now, it is well established that the low thermal gradient heating associated with microwaves is advantageous to several food processing applications. The major advantages vis-a-vis microwave processing include speed of operation, energy savings, precise process control, faster start-up and shut-down times. Microwave

energy is cur ently being used for several food processing operations including cooking, dryi , tempering, baking and sterilisation.

Industrial use of microwave energy for food processing became a reality with the development of continuous conveyors over almost 3 decades age. Both resonant carry system and wave guide system are in use commercially. Development of microwave food processing equipment has been dependent on available generator types and power levels. Most 2450 mHz systems are multi-modular units employing a series of 2.5 to 3 kw magnetrons. The 915 mHz systems utilise a single magnetron ranging from 25-50 kW due to the absence of low-powered sources at this frequency. In addition to microwave-only systems, some commercial units combine microwave and conventional heating sources to get better quality products. Conventional heating is resorted to for getting brown colour, facilitating drying, reducing surface bacteria or preheating the product. Concerns about the safety of microwaves have been expressed from time to time which also has contributed to the slow acceptance of this modern heating marvel. Although athermal effects of microwaves have been reported, the sole result of microwave interactions in foods seems to be their heating impact. Environmental concerns increasingly being articulated world over, can be expected to make microwave system readily acceptable to the industry as well as the consumer during the present decade itself.

1.4 Modified Atmosphere Packaging (MAP)

MAP has been in vogue during the last few years especially for extending the shelf-life of fresh produce in the marketing chain. Recently, it has been shown that MAP can also be effective in the preservation of sea foods like fish. Packaging seafish in an atmosphere of CO_2 was found to delay spoilage and provide consumers with a high quality product. Though it may be difficult to suggest standard CO_2 concentrations in MAP for all varieties of food, CO_2 levels from 20-100% can achieve the desired result. Optimal concentration of CO_2 is influenced by the fish biology, initial microbial load, gas to fish ratio, packaging mode and generally upto 60% CO_2 levels are used in practice. MAP is not effective alone and the product needs to be refrigerated below 3.3°C to retard development of *C. botulinum*. At the low recommended temperature, the gas mixture extends the lag phase and slows generation time of spoilage bacteria. Additional treatments such as potassium sorbate and low dose irradiation can further enhance the effects of CO_2.

Unwrapped chilled seafood can be CO_2 treated in bulk containers where one can get a high gas-to-fish ratio and therefore more effective preservation. Master packs alleviate some of the problems inherent to bulk shipment. Under this mode, the product is packed in trays and sealed with gas permeable film which are then placed in large gas impermeable containers and modified atmosphere created. Individual MAP modes are also being used and under this regimen seafood is placed in a flexible bag with or without a performed tray, flushed with the desired

gas mixture and sealed. An integrated form-fill-seal machine can also be used. The quality of packaging material used is critical to the success of MAP. The quality parameters desirable include material strength, clarity, thickness, thermoformability, ability to form a seal, seal strength, antifogging properties, permeability, retained solvent levels, taint, ease of displaying stickers and advertising logo and storage stability

In spite of the efficacy of MAP as demonstrated by various studies, there are areas of concern when its wide scale application is considered. Since the product is in MAP from processing to consumer, the possibility of temperature abuse is great and during retailing, the MAP product may be mixed up with other products not requiring tight temperature control. Also at the household level, domestic refrigerators are often maintained at temperatures above 6°C and hence the MAP product is likely to be exposed to dangers of spoilage. Intrinsic presence of psychrophilic *C. botulinum* in seafish calls for further caution when MAP is used.

1.5 Modified Spiral - Wound Cross-Flow Membrane System

Membrane filtration has come to stay as a clean process for many of the food processing requirements and with a large variety of polymer membranes available almost all separation needs of the food industry are being met. The economic feasibility of membrane application is determined by the fouling potential of the material to be processed as it will adversely affect the rate of filtration. The overall size of the system is decided by the rate of filtration and this, in turn, influences the capital and operating costs. There are several ways by which membrane fouling can be minimised. These include a) selection of membrane polymer which is least likely to interact with the foulant or modifying the membrane surface to lessen the fouling b) increase the flow velocity to 10-20% above the normal velocities c) use pulsed feed flow, reversing the direction of feed flow and air sparging d) pretreat by either pH or temperature adjustment e) optimise prefiltration, recovery levels and cleaning frequency. Another important method of reducing the impact of fouling is modifying membrane element design. This can be accomplished by either using an outer cover in the conventional design or using various feed spacers.

Formed-in-Place Membranes: A major concern in using any membrane system is the performance in accomplishing the required separation with an economically acceptable permeate flux rate. Both these parameters are drastically affected by membrane fouling. Like cast membranes, a cleaning regimen needs to be established to ensure maximal performance. However, formed in place membranes (FIP) can be economically removed and new one formed to achieve optimal performance. FIP membranes are made by deposition of either inorganic solutes or organic polymers within the matrix of porous tube which can be made from a variety of porous materials including carbon, ceramic or standard steel. In such cases, removal-reformation layers can be designed such that the procedure for reforming membranes can be considered self-limiting. As a result,

no special operator skills are needed and the entire FIP process can be automated much like a typical CIP procedure.

2. NEW INGREDIENTS AND PRODUCT CONCEPTS

2.1 Hydrocolloids - Fat Replacement Aids

The protein mania of fifties and sixties yielded to fibre flenzy of eighties and presently discernible is "fatphobia" as most consumers are becoming aware of the nutritional implications of high fat intake in foods. This situation has led to intense developmental activities to identify acceptable fat replacers that can be used in foods lowering the calories as well as preventing cholesterol build up. Organoleptically oily mouthfeel is due to a combination of several basic parameters which together form the recognisable edible sensation of fattiness. These parameters are viscosity, lubricity, absorption/adsorption and others not yet defined but include adhesiveness, waxiness, mouthcoating etc. Ingredients which provide these stimuli can mimic fatty mouthfeel and perception and therefore are ideal to replace fat in formulated food products. Ingredients that have fat mimicking properties can be grouped under 10 distinct categories. Synthetic fat substitutes and emulsifiers are true fat replacers as they can behave like fats and oils providing the same mouthfeel and functional attributes. Emulsifiers do not have any advantage when used as a fat substitute since they have same calorie contents as fats. Synthetic substitutes suffer from want of safety clearances and approval in most cases. Other fat replacers are all based on hydrocolloids.

Synthetic fat replacers include sucrose polyesters such as olestra, esterified propoxylated glycerol (EPG) dialkyl dihexydecyl malonate (DDM) trialkoxytricarballylate (TATCA) and trialkoxy citrate (TAC). So far, none of these substitutes have been cleared for use in food.

Hydrocolloids are long chain polymeric materials that thicken or gel in aqueous systems. They provide viscosity in all cases and often gel under certain conditions. They have other useful properties like emulsifying, stabilizing, encapsulating, and whipping. Recently, hydrocolloids have been associated with physiological functions as a soluble fibre and ability to mimic and replace fat in foods. The terminologies like hemicelluloses, beta-glucans, malto dextrins etc. are also used to describe hydrocolloids. Gum arabic, gum ghatti, gum karaya, gum tragacanth, gum accacia, guargum etc. are natural hydrocolloids known since ancient times. Agar, alginates, carrageenans and furcellarans are derived from sea weed while pectin, hemicellulose beta-glucans and pentosans can be extracted from gum plants and cereals. Gelatin and chitin are of animal origin. Xanthan, gellan, curdlan, pullulan, scleroglucan and dextran are produced by microbial fermentation. Modified cellulases and starches, propylene glycol alginate, low methoxy pectin and hydroxypropylguar are derived products from natural food components. Synthetic substances having hydrocolloid activity

include polyvinyl pyrolidone (PVP), polyethylene oxide polymers, acrylic acid polymers, methyl vinyl ether, polyvinyl alcohol (PVA) and polyethylene glucose polymers.

A good fat mimicking system strives to achieve the viscous-lubricous absorptive profile of the fat itself. This can be achieved by using a combination of hydrocolloids, soluble bulking agents, micro particulates, sugars and functionally related materials. Most fat replacer systems range from a single component ingredient in products such as salad dressings to more complex multicomponents systems such as ice cream products.

2.2 Polydextrose For Lower Calorie Foods

Litesse is a premium quality polydextrose bulking and fat sparing agent developed by Pfizer Inc, New York with manifold functions when used in foods. It improves the mouthfeel and viscosity, acts as a freezing point depressant and can be employed as a flavour carrier. As it has a bland taste and only one calorie per gram, it can find extensive application in a wide variety of improved tasting low calorie foods. Litesse is produced by a process of polymerisation through randomly bonded condensation and incorporating sorbitol and citric acid. It is a water soluble white to cream coloured amorphous powder forming a clean melt at 130°C, similar to sucrose. A 10% solution has a pH of 2.5 to 3.5. The process ensures a molecular weight of less than 22,000 so that one gets the desired solubility characteristics. The functional property of litesse makes it eminently suitable to be deployed for reduction of calories in foods, imparting bland taste, increased viscosity, depressing the freezing point, and imparting humectant function, all without adversely affecting the water activity. FDA of USA defines litesse as a partially metabolised water soluble polymer prepared from D-glucose with small amounts of sorbitol and citric acid and allows its use in frozen dairy desserts, baked goods and mixes, confections and frostings, salad dressings, gelatins, puddings, fillings, candies and chewing gum. Besides, litesse is approved for use in 28 other countries in the world. Foods containing litesse have to caution the consumer that sensitive individual may experience a laxative effect from excessive consumption of the product.

2.3 Oatrim As A Fat Substitute

Oatrim, a maltodextrin, derived from oats is a fat substitute with the ability to lower blood cholesterol levels, both as a replacement of animal fats and through the action of beta-glucan. This important and useful ingredient was developed by the National Centre for Agricultural Utilisation Research of USA in 1991 and the patented process of its preparation involves conversion of oat starch in the flour or bran to maltodextrins using alpha amylase for starch liquefaction. Malto dextrins are created by cleaving the starch amylase and amylopectin chains. Maltodextrins with low dextrose equivalent give the most suitable fat substitutes. The conditions of enzyme treatment were optimised to achieve conversion of the substrate so that the soluble fibres bound in the cellular matrix are liberated.

After inactivating the enzyme, the soluble material containing the maltodextrins and beta-glucan are separated from the insoluble components by centrifugation. Oatrim containing 1-10% beta-glucan can be prepared by varying the process operation. In addition to the cholesterol lowering activity, the ingredient has significant fat-like quality based on the combination of the maltodextrin and the beta-glucan. Other maltodextrin gels from starches of corn, tapioca or potato do not possess this quality - Oatrim forms a fat-like gel on heating and cooling a 25% dispersion. The calorific value is less than one per gram as compared to 9 per gram for fats. Food applications are in ice cream and frozen desserts, milk shakes, hot chocolate, instant foods, egg yolk, salad dressings, soups, sauces and gravies, baked goods, peanut butter, mayonnaise, margarine, meats and dietetic foods.

2.4 Cellulose Gel for Fat-Free Foods

As against 20% of calories recommended to be derived from fat in a nutritionally sound diet, most consumers in developed countries and many in developing countries consume fat, far above this level, obviously due to affluence. The concern over the intake of high levels of fat has triggered consumer demand for low or no-fat foods posing enormous challenges to Food Technologists world over in the area of formulations containing low fat or no fat at all. Such formulations have to compensate for the loss of body and mouthfeel, opacity, slip, mouth coating, flavour masking, fatty flavour and a variety of other functional properties indigenous to fat. These challenges are further compounded by the fact that no two fats are similar and no two food formulae are alike. Microcrystalline cellulose alone or in combination with xanthan gums can, to a great extent, provide the rheological and mouthfeel properties to fat reduced formulae.

Blends based on microcrystalline cellulose have been developed with varying proportions of maltodextrins, xanthan gum, guargum, etc. These blends containing microcrystalline cellulose 75-90% and other ingredients such as guargum and xanthans gum singly or in combination can be used in low fat food products at levels of 0.75 to 3% depending on the sensory quality desired.

2.5 Non-Dairy Frozen Desserts

The food industry has developed many dairy-like food products, such as margarine utilising materials of plant origin. Such developments are in response to rising costs and limitations on the supply of dairy ingredients together with the advantages offered by plant materials in terms of economics, availability and nutritional properties. Individuals who are intolerant of lactose or of bovine milk proteins or who are concerned with saturated fat intake or with the observance of religious dietary laws constitute a ready market for non-dairy products. Of particular interest to such groups is the development of non-dairy ice creams like frozen desserts in which milk proteins and butter fat are partially or completely replaced by plant proteins and vegetable oils. During late eighties, several such products were launched in the international market with varying degrees of

success. Recently, an all vegetable frozen dessert with acceptable sensory qualities has been developed based on protein isolate derived from yellow field peas. A formulation containing by weight 63.65% water, 11% sugar, 10% glucose solids, 10.5% margarine, 3.5% pea protein isolate and 0.35% stabiliser and emulsifier compared generally with dairy ice cream in terms of viscosity, melting behaviour and sensory qualities.

2.6 Low-Fat Meat Products

Proper nutrition and anxiety over fatty foods are major factors influencing consumer food choice all over the world. A variety of strategies have been evolved or being developed for reducing fat levels in meat products as these products are increasingly being shunned on account of the quality and quantity of fat present in them. There is a move currently to define low fat foods, as those containing less than 3% fat when consumed. Most of the products in the market are based on dilutions of fat content by fillers without affecting drastically the sensory qualities. The techniques being used include modified starches, use of carrageenan, soy proteins, oat bran and fibre, modified starches, functional blends, maltodextrin, plant oils etc. Invariably, the above approaches are based on replacement of fat with water and binders or extenders.

Attempts are now being made to explore the possibility of removing fat and cholesterol using mechanical methods. Super critical fluid extraction technique is being considered to reduce fat in ground meat and derived products. 103-310 bar pressures have been used to achieve significant fat reductions. Although this process can remove fat from high moisture products, its effectivenss is reduced in case of products containing 40% or more fat. Recently, a separation process has been used to separate the lean portion from the fat in fresh beef and pork trimmings. Microwave heater pads, designed to absorb fat lost in the cooking, provide another effective way of reducing fat in meat products. A number of pads have been developed for this process.

2.7 Modified Fats

Fat has been implicated as a source of health disorders if consumed beyond limits and thus has led to furious development activities to replace or cut down fats in processed food products. However, it is lately being recognised that fat is a necessary part of human diet as it is the sole source of fat soluble vitamins and essential fatty acids. Probably, greater discretion is called for in choosing the type of fat in the formulation and consumers can expect fats to emerge as a food ingredient with some potential to prevent and treat many diseases.

Medium-chain triglycerides (MCT) is a well established fat ingredient presently in use, formatting the nutritional needs of hospitalized patients and others with special dietary needs. As medium chain fatty acids (C6-C12) are not incorporated into chylomicrons, they are unlikely to be stored in the adipose tissue of the body. Instead, they are oxidised for energy in the liver and provide

dense source of calories. While MCT has many advantages, a minimum amount of long chain diglycerides (LTC) is still necessary to meet the essential fatty acid requirements of the body. A physical mixture of MCT and LCT is commonly used and forms the basis of enteral and parenteral nutrition. Structural lipids which are obtained by the process of interesterification have been evolved to provide a chemically integral product having better metabolic and absorption characteristics. Besides, Omega-3, 6 and 9 fatty acids are included in structured lipids to promote health and nutrition. Structural lipids offer several advantages like conferring improved immune function, not impairing reticuloendothelial systems, lessening cancer risk, preventing thrombosis, lowering cholesterol levels and improving the nitrogen balance. Though structural lipids development has targetted hospital patients as the likely users, it is time that this concept is expanded to benefit enlightened consumers looking for more safer foods. Recently, Proctor and Gamble of USA have reported development of a cocoa butter substitute named 'caprenin' by combining medium chain fatty acids with behenic acid which gives only half the calories as compared to cocoa butter when used in chocolates and can expect further development once such products are cleared for use.

2.8 Artificial Sweeteners

There is an insatiable appetite for sweeteners though awareness about nutrition restricts sugar intake on a voluntary basis. The current trend is to look for intense sweeteners that can be used as sucrose substitute without any toxicological hazards. Present sucrose alternatives viz. saccharine, cyclamate, aspartame and acesulfame-K fall short of expectations in one way or the other in delivering the complete sucrose taste experience. This is due to the fact that these sugar substitutes arrived on the scene more by accident than by design. With the existing knowledge about the perception of taste and its relation to geometry of chemical molecules, attempts are being made to synthesise more effective sweeteners that can provide palate satisfaction when used in very low concentrations. Through use of structure-activity and modelling studies, many new sweet structures have been discovered leading to preparation of several new sweeteners, in the laboratory. One of the most potent sweeteners, sucrononic acid is 200,000 items as sweet as sucrose. Of course, these chemicals are required to be explored further to establish their safety, economic and commercial aspects.

Basic research on sweeteners has led to discovery of sweetness antagonisers and if this work is carried out to its logical conclusion that it should be possible to consider sucrose as a functional ingredient and whose sweetness can be masked by inhibitor ingredients. Similarly, search has to be made to identify sweetness potentiators which can boost the sweetness value of sucrose and thus enable to get required degree of sweetness at far lesser concentration so that calorie conscious consumers may not shun its use.

2.9 Pectin For Fat Replacement

Fat replacer called "slendid" is a form of pectin finding application in frozen desserts, dressings, soups, cakes, cookies, processed cheeses, yoghurts and a variety of other food products. It can reduce the fat content dramatically in many products without affecting the stability or sensory attributes. It is heat stable for application that requires retorting, microwaving, baking, sterilizing or pasteurizing. Products are stable in presence of salt and under a wide pH range of 2-8. The fat replacer usually constitutes less than 5% of the final product though in most applications, it contributes less than 1%.

2.10 Acesulfame-K - A Sucrose Substitute

Non availability of high intensity sweeteners suitable for use in baked goods has been a handicap in preparing low calorie products through baking process. Saccharine, though stable under high temperatures gives after-taste, while aspartame loses its sweetness during baking. Acesulfme-K, which is the potassium salt of 6 methyl 1, 2, 3-oxythiazine-4 (3 H) one -2, 2-dioxide is 200 times as sweet as sucrose and has a sweetness profile similar to sucrose. When used in combination with sorbitol, it improves the initial sweetness and also rounds out the flavour. Acesulfame-K is heat stable and leaves no after-taste after baking. It is approved in many countries for use in dry mixes for beverages, gelatin, puddings, coffee, creamery, etc. and FAO-WHO has established an acceptable daily intake of 0-9 mg per kg body weight. As the sugar replacement affects adversely the bulk properties of the product formulated, bulking agents, such as sugar alcohol, maltodextrins and insoluble fibre powder are used in conjunction with acesulfame-K.

3. PROCESS CONTROL AND INSTRUMENTATION

The food processing industry world over has been slow to adopt recent advances in intrumentation and control common in chemical, pulp and paper, steel, aluminium and other process industries. Food processes are generally not easy to automate. Natural foods exhibit more variability than the natural raw material used as feed stocks for most other industries. Furthermore, food feedstock variations usually are difficult or impossible to measure. Normally, a poor feedstock appearance, odour or taste will result in a product with poor appearance, smell or taste. While colour can be somewhat easier to sense, there are no satisfactory on-line sensors for most odours and tastes. Many advances in process control technology have been made in recent years, primarily as a result of the availability of inexpensive computing power through microprocessor. Techniques such as dynamic matrix control, model reference adaptive control and expert systems have become common in a variety of process industries. Recent developments like fuzzy logic and neutral networks are not process control technique such as feedback closed-loop control. They can be used effectively to take appropriate decisions for improving yield, quality etc. Safety shut-down

systems, different from control system are increasingly being used in chemical and other industries in order to prevent costly mishaps but they are not suited for food industry as they may result in frequent shut-downs leading to quality complications. Probably, one may have to wait for the arrival of "intelligent" safety system which will resort to shutdown as a last resort.

Making single quality product requires that the process equipment and measurement instrumentation operate both accurately and predictably. A modern trend is to include equipment diagnostics in the instrumentation to determine drifts or faults in operations.

The basic sensors used in process control measure such physical properties as temperature, pressure, level, flow, mass, viscosity and density. Product dimensions of length, weight and manufacturing machine parameters of distance, torque and speed can also be accurately measured. Electrical properties of voltage, current, power and phase angle are commonly measured for manufacturing processes. Most of the work in composition analysis has concentrated on using specific ion concentration, hydrogen ion concentration, gas and liquid chromatography, mass spectroscopy, refractive index, electrical conductivity, infrared absorption, colour, nuclear radiations caused ionisation and microwave absorption. Specific instruments for many compositions have been developed on the basis of one or more of these. In addition to the use of most of the basic sensors, food processors have used many of the sensors developed for other industries such as viscosity, moisture, colour, conductivity and pH measurements. However, very few on-line composition measurement instruments have been developed specifically for food processing sector. Specific sensors are needed to be developed for measuring very high viscosities, percentage moisture content (both free and total), colour of highly uneven surfaces, thickness of discrete items in motion and a large slate of chemical and biological components.

3.1 On-Line Sensors For Food Processing

The importance of on-line measurement compared to laboratory analyses for effective process control lies in the fact that response rate in the latter case is very slow resulting in controllable damages. Sampling and subsequent analyses in a laboratory involve a time delay ranging from a few minutes to several days depending on the complexity of the analysis. Sample size and sampling mode can affect the results and their correlation with the process parameters. On-line sensors and quality instruments can provide real-time product information establishing thereby a link between the process and its control. Sensors for the measurement of physical attributes such as temperature, pressure, flow rate, viscosity and liquid level have been routinely used in food industry. Sensors for these attributes are continuously being improved and made more and more industry specific. However, advances in sensor technology will have to take into consideration the need of the food industry to measure chemical attributes such

as moisture, fat and protein content. Advent of biosensors may even make it possible detection of pesticide residues in foods. Increased efforts in the coming years will see development of appropriate biological and chemical sensors, near infrared reflectance and transmissions, analyses for moisture and compositional measurements, process refractometers for measurement of solids content microwave and radio frequency measurement of food moisture. Once adequate and appropriate sensor systems are developed for food industry, it is imperative that efforts are focussed on sensor fusion in order to combine industrial data into patterns that provide a higher level of information than is possible from a single source and to couple this information with the use of expert systems performing process control.

3.2 Fibre Optic Sensors

The fibre optic sensors utilise an extrinsic Fabry Perot interferometer to spectrally moderate light in proportion to pressure, temperature or refractive index. As they are based on spectral modulation instead of amplitude modulation, they are not affected by such common phenomena like fibre bending, connector losses and source and detector aging.

The combination of light transnmitting optical fibre and silicon sensors can be used to measure temperature, pressure and refractive index. These sensors are intrinsically safe, immune to electromagnetic and radio frequency interferences, capable of more accurate measurements in electrically noisy environments, small in size enabling quick measurements. The sensors can be connected to an opto-electronics module as far away as 3000 ft. The probes can be as small as 0.032 inch in diameter. They are usually packed in 1/8 inch diameter stainless steel ruggedised probe assembly which is interfaced to process vessels or pipes using off-the-shelf compression fittings.

4. BIOTECHNOLOGY

4.1 Genetic Engineering for Modified Lipids

Fatty acids in foods have a critical role in deciding about their stability, flavour, texture and nutritional quality. There has been considerable interest in reducing the saturated fatty acid content of foods. Continuous efforts are being made to develop vegetable oils with high mono-unsaturated fatty acid contents. There is also considerable interest in increasing the ratio of dietetic intake of w-3 relative to w-6 fatty acids. Development in recombinant DNA technology, plant regeneration and transformation and related areas of biotechnology will go a long way in augmenting efforts in breeding and genetics for improving the quality of plant derived lipid. Significant successes have been reported in breeding for altered fatty acid composition of vegetable oils to improve their food value in some crops like sunflower and canola. In other cases, not much headway has been possible. As the biosynthetic pathway and mechanism of major fatty acids have

been well understood, biotechnological approaches to the alteration of fatty acid composition may meet with dramatic success in the coming years.

Several of the genes controlling key biosynthetic steps in fatty acid biosynthesis have already been cloned. These include genes that encode proteins involved in saturated fatty acid biosynthesis such as acetyl CoA carboxylase, fatty acid synthase and acyl carrier proteins. Genes that encode enzymes involved in fatty acid length determination like thioesterases have also been cloned. There are three major unsaturated fatty acids found in varying levels in most plant tissues, viz. oleic, linoleic and -linolenic acids. These are formed by consecutive desaturation from stearic acid by desaturase enzymes. There are at least eight genes that control the activity of specific desaturases in plant leaves. Animals require but do not have the ability to synthesise ω-6 and ω-3 fatty acids and hence have to rely on dietary sources derived from plants. Efforts to genetically engineer plants for altered fatty acid composition using cloned lipid biosynthetic genes are in progress. A good foundation has been laid to achieve further progress in this direction. Genetic engineering may facilitate alteration in fatty acid make up beyond changes achieved by classical breeding.

4.2 Food Biotechnology

The first research wave in plant biotechnology has been to instil traits that boost productivity such as control of insects, weeds and disease. Taming natural organisms to perform new tasks in the new area in which biotechnologists have pinned their hopes to expand world food production. Efforts are on to integrate nitrogen fixing genes of *Rhizobia* into wheat and corn. During the last few years, biotechnologists have been able to transfer genes into about three dozen species of plant. Genetically, improved soyabean, corn, cotton, rice, oilseed rape, sugar beet, tomato and alfalfa crops are expected to be available during the present decade. Scientists have isolated genes that permit them to change the starch and sugar contents, create biodegradable polymers for the chemical industry that could provide a renewable source of plastics independent of the petroleum supply. Genes have been transferred to enable plants produce precious human pharmaceuticals such as blood proteins, antibodies, enkaphalin, melanin etc. Among other genetically engineered consumer food products which are likely to emerge in the near future, include bruise free fruits, caffeine-free coffee beans, perishable with colour-coded freshness indicators, cheese that ages quickly, low calorie sweeteners, fat free oils, extra lean pork, low fat chicken and transgenic livestock.

5. CONSUMER HEALTH AND FOOD SAFETY

5.1 Food Safety and New Technology

In recent yers, a lot of attention is being focussed on safety aspects of foods that are being produced by new technologies and practices. Intense speculation

is prevalent regarding pesticide residues on food crops, naturally occurring toxicants in commonly eaten food materials, animal drug residues, toxic compounds formed during the curing and cooking of meat and fish, radiolytic products in irradiated foods and incidence of *Salmonella* in poultry, eggs and fish. Consumers are bewildered by arguments and counter arguments by the pro and anti-processing lobbies as the so-called hazards are not visible to them during their day-to-day handling of foods. Doubts have often been raised as to the veracity of technical reports, appropriateness of experimental design and interpretations and conclusions. Food industry generally considers threat to food safety coming from microbiological spoilage, pesticide residues, mycotoxins, package product interactions, chemical additives and carcinogenic compounds.

Food borne diseases remain one of the most common and important causes of illness and death in many parts of the world. Some of the recently identified microorganisms responsible for food related illnesses include a) *Campylobacter*, which gets into the human system through poultry meat causing acute diarrohea b) *Yersinia enterocolitica*, *L. monocytogenes* and *S. enteridites* cause severe infections especially in children and elderly consumers. c) *Vibrio vulnificus* causes serious illness in pregnant women, unborn children, the elderly and low resistance category of population. New concerns relate to increasing evidence that food borne microorganisms may cause diseases in organ systems other than gastro intestinal tract. Reactive arthropathy and rheumatoid disorders are reported to be the after-effects of salmonellosis. Listeria can migrate to the blood causing septecemia and meningitis. Yersiniosis can produce subsequent arthritis. *E. coli* 0157:H7 and some related enterohemorrhagic *E. coli* may become one of the greatest hazards for the consumers in the coming years.

Transfer of safe pesticidal qualities to food crops through biotechnology effective integrated pest management programmes, and development of environment friendly agro chemicals and livestock drugs are needed to combat the dangers posed undesirable residues in consumer foods. Application of biotechnology has opened up vast opportunities to create food materials with well defined chemical, biological, nutritional and other desirable characteristics. Major concerns vis-a-vis these raw materials are their safety to be established beyond any grain of suspicion. Impurities generated and passed on to the derived products by genetic engineering may include host cell proteins, endotoxins, proteolytic clips, amino acid sustitutes, certain metheoninylted products, and endogenous viruses. It is desirable that a balance is struck between the necessity to give freedom to biotechnologists to develop new materials and the need to protect the consumer and environment from hidden dangers.

Many new techniques now being considered for commercialisation on a wide scale such as microwave radiation, high pressure treatment, ultra high temperature processing aseptic processing of particulates by ohmic heating, athermal processing with considerable energy economisation, all require safety evaluation before consumer can be expected to accept products made by them.

Similarly, appearance of designer foods to meet specific health/disease requirements has necessitated evolving protocols to confirm their safety as they are likely to be consumed in large quantities displacing conventional diets. Migration of packaging materials into the contents, generation of pyrolytic products at ultra high temperature processing conditions and use of susceptors for microwave preparation of specific food products also call for caution and further study.

Development of new food ingredients, genetically improved plants and animals and innovative food processing and packaging technologies have created exciting possibilities for both the industry and the consumers in terms of vast array of new products. But simultaneously, they also call for greater vigil and safety evaluation efforts before they are cleared for mass production.

5.2 Designer Foods

Designer foods are: 1) foods developed with a specific function such as reducing fat, preventing or treating disease or meeting the particular needs of a specific group 2) foods supplemented with ingredients from edible plants that are rich in cancer preventing substances 3) foods modified by processing or genetically engineered to prevent heart diseses' osteoporosis or other crippling diseases 4) foods produced by formulating two or more foods together with standardised phyto-chemical content 5) foods having a fruit or vegetable base with properties of preventing diseases 6) foods defined as neutraceuticals providing medical or health benefits and 7) foods physiologically functional, designed and processed to work for the protection of body rhythm and recovery from disease.

The claim that consumption of a particular food can reduce a person's risk of acquiring a disease may be premature, misleading and easily exploited. It is also possible that food designed for decreasing the risk of one disease may actually increase the risk of another. With the present level of knowledge, it may be difficult to emphatically come out with designed foods unless all claims are substantiated by clinical trials. Perhaps, it may take many more years before consumers can enjoy the benefits of designer foods which will become a reality only if major food industries pool their resources to establish beyond doubt the effectiveness of such products in combating health disorders.

5.3 Cancer Preventive Foods And Ingredients

It has been known for a long time that every molecule in the human body originates from the diet and that the absence of certain essential nutrients can create a predisposition to illness. Late realisation is dawning on the scientific community that many preciously unappreciated components of our diet may prove important in preventing such chronic diseases as cancer. Within the last decade, epidemiological and animal studies have indicated vegetables, grains and fruits as possible sources of substances having cancer preventing properties. Heavy

consumption of alcohol has been linked to higher incidences of cancers of the upper alimentary tract and liver. Diets high in fat appear to contribute to breast, pancreatic and colorectal cancer. Fibre, vitamins A, C and E and numerous other substances appear to exhibit cancer preventing properties. About 40 foods including garlic, cabbage, lettuce, soybeans, ginger, onion, tomato, some grains like wheat, flax and brown rice and herbs have been identified as anti-cancer foods. Approximately, 14 classes of dietary phytochemicals are present in common foods which can interfere with and potentially block the biochemical pathways that lead to malignancy in animals. These are sulphides, phytates, flavonoids, glucarates, carotenoids, coumarins, monoterpenes, tri-terpenes, lignans, phenolic acids, indoles, iso-thiocyanates, phthalides and polyacetylenes. Studies are underway to provide an integrated scientific understanding of roles these phytochemicals play in preventing cancer in mankind. Once this is understood, one can expect a new industry to emerge to cater foods for disease prevention. It is not inconceivable that foods that once contributed to illness and disease may be reconstructed in the next decade or two to offer significant health benefits.

6. MISCELLANEOUS

6.1 Odour Deterioration in Foods

A variety of off-flavours present in foods due to many reasons can make them unacceptable to the consumer. These off-flavours arise out of contamination of the food by chemicals generated from air-borne, water-borne and packaging materials. Also, food components may undergo degradation due to oxidation, non-enzymatic browning, enzymatic reactions or light induced reactions.

Proximity of the production unit to environments contaminated with undesirable odours often leads to off-flavour developments in the product. Thus, food products like biscuits, chocolates, cakes, confectionery, meat etc. can pick up off-flavour resembling chlorophenols, tar, catty off-flavour, diesel oil, petrol vapour, oxidised oil and others from the factory environment.

Water can be an effective medium transferring objectionable odours to food supply. Quality of water influences the flavour of marine animals, thereby providing off-flavours to final product made therefrom. There have been instances when incoming tainted water contaminates the food. In many cases, the water gets contaminated in the plant as it can pick up various chemicals from boiler treatments, polymeric piping or cooking operations.

Pesticides, disinfectants and detergents occasionally contribute to off-flavours in foods. Products like cakes, milk powder, canned peas, canned raspberries, pork, tomatoes and smoked bacon have been known to be affected by off-flavour picked up from pesticides and disinfectants used during processing.

Appearance of soapiness in products like butter is attributed to use of detergents based on C_{10}/C_{12} fatty acids. Butter is tainted due to the presence of alkylbenzene sulphonates which are used as sanitising agents for cows molar and dairy equipment.

Off-flavours due to packing materials are frequently encountered in the food industry, exception being glass containers. Paper-based packaging system contributes some off-flavour due to use of adhesives and printing inks having strong odours. While plastic packaging offers numerous advantages to the manufacturer and consumer, it also brings along unique off-flavour problems. Incomplete polymerization in the packaging material often taints food. Desirable flavours in the food tend to dissolve in the packaging material leading to reduced flavour levels. Metal cans provide off-flavour to the contents due to residual volatiles in the sealant which is used to ensure aseptic seal closure. From the practical point of view virtually any packaging material can contribute to off-flavour in foods.

Microbial spoilage is the most common source of off-flavours in non-preserved foods. Production of undesirable primary metabolites, incidental chemical transformation of food constituents and residual enzyme activity after cell deth can all lead to off-flavour development.

6.2 New By-products From Citrus Waste

The major by-products of processed citrus are dried pulp, molasses, washed pulp solids and essential oils. Some modern citrus industry processing techniques are applicable to recovery and manufacture of these traditional products. New isolation procedures, however, have emerged recently to recover a few useful constituents from citrus residue and to upgrade liquid process streams for use in foods. These include hesperidin, naringin, limonin, juice vesicles, enzymes, isomers, flavour chemicals and washed pulp solids. Applications of new procedures include recovery of high purity flavonoids by combining ultrafiltration and resin adsorption, aqueous essence concentrated by reverse osmosis, supercritical fluid extraction folding of cold pressed oil and enzymatic synthesis of alpha-terpineol from citrus limonine. Limonine is used extensively as a raw material for synthesis of tackifying resins for adhesive industry besides finding application in pesticide formulations and flavour blends. Naringin is reported to have protective actions against thermal auto-oxidation in palm oil. The flavonoid derivative neo-hesperidine dihydro-chaslone is a prime candidate as a sugar substitute. Limonoid glucosides also are being mentioned as possible anticancer agents.

6.3 New Browning Inhibitors

Sulphating agents are commonly used to prevent black spot formation in shrimps during processing. Commercially, a one minute dip into a 1.25% sodium metabisulphite solution allowing a sulphite residue of 100 ppm on the shrimp

meat is commonly practised. Adverse reactions to sulphites with particular concerns for sensitive asthmatics as well as other risks associated with their use are well known by now. Several deaths have occurred from exposure to sulphur dioxide and heightened consumer awareness of the risks associated with sulphited foods has created a need to look for an effective but safe alternative to sulphite in foods. Recently, it has been brought out that several 4-substituted resorcinols are effective inhibitors of polyphenol oxidase activity in a variety of foods. These compounds also inhibit enzymatic browning in foods such as shrimp, apple, potato, avocado and grape juice. Specifically, 4-hexylresorcinol is considered most effective resorcinol derivative in retarding melanosis in shrimp when used as a 50 ppm solution for dip for one minute. The residue in the meat does not exceed 3 ppm. 4-hexylresorcinol has been in human consumption since 1920, has been well studied for its toxicological properties and is considered as a GRAS chemical. The use of 4-hexylresorcinol and 4-substituted resorcinols as browning inhibitors has potential application to many foods and beverages, which include sliced potatoes, apple slices, avocados, and white grape juice. It is worthwhile to explore the feasibility of using this chemical in many other foods where browning is a critical problem.

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INVITED PAPERS - ABSTRACTS

POLICY ISSUES

***Venue*: Kalamandir**

Tuesday, the 7th September, 1993

A1.16

HEALTH AND NUTRITION CONSEQUENCES OF MODERN AGRICULTURAL TECHNOLOGY

C. Gopalan

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Modern agricultural technology had helped several developing countries to overcome threatened acute food grain shortage. However, while wheat and rice production were significantly augmented, millets, pulses oilseeds and most importantly horticultural products had not benefitted, resulting in an unhealthy distortion of the pattern of availability of food-stuffs, not conducive to optimal nutrition. Intensive irrigation, and heavy use of high-analysis chemical fertilizers have resulted in salination and alklisation of soils, and depletion of soil micronutrients which not only threaten food grain yield but also pose health/nutritional hazards. The accumulation of pesticide residues in body tissues could pose yet another health hazard. These developments call for appropriate controls and safeguards.

A1.03

FOOD SECURITY IN THE 21ST CENTURY: THE CHALLENGE TO ASIAN FOOD SCIENTISTS

Joseph Hulse

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1628 Featherston Drive, Ottawa K1H 6P2. Canada

At the UNCED 'Earth Summit' in Rio, research on climate change and conservation of biodiversity were given high priority. Climate and genetic diversity are influenced by natural phenomena and by human activities. Both are critical to agriculture and food security. The planet's atmosphere, land and water resources are being seriously degraded by energy generation and utilisation, by increasing industrial and communal waste and pollution.

With rising population and prosperity, Asian demand for processed foods is expanding and diversifying. Among non-vegetarians, increasing demand for animal and fisheries products may impose a stressful burden on natural resources and ecological stability

Plant breeders and geneticists have assembled a collection of the principle food crops of impressive genetic diversity, with over 640,000 genotypes of cereals, legumes, oilseeds and root crops in international germ plasm banks.

Food scientists need now to study systematically how among these collections, useful properties vary with genetic diversity. The paper will review the critical characteristics of tropical cereals, pulses and oilseeds and suggest means by which these crops might be utilised more efficiently, economically and ecologically by food processors: and how they can contribute more effectively to Asian food security.

A1.06

POTENTIALS FOR INCREASING AGRICULTURAL PRODUCTIVITY IN INDIA: TOWARDS CHANGING THE ECONOMIC SCENARIO AND WIPING OUT UNEMPLOYMENT AND POVERTY

G. Rangaswami

159, D.K.A. Nagar, Valasaravakkam, Madras-600 087, India

In order to achieve full employment and lift the entire population above the poverty line in the next ten years, India needs to create additional employment for 100 million persons. This is possible only through a new thrust in agriculture, with a liberalised commercial approach. While maintaining the present emphasis on small and marginal farmers, and landless labours development programme to make the country self-sufficient in foodgrains, oilseeds etc., special emphasis needs to be given for substantially increasing the production of vegetables, fruits, fish, sugar, cotton, silk and the related industries to produce value-added products for the internal and international market. Adequate technical, skilled, unskilled and managerial manpower, as also the technology for doubling and trebling the production per unit of land, water, sunlight and other material and scientific inputs, are available in the country and this will be backed by continuing inflow of newer technologies in the coming years.

A1.07

ARID FOOD CROPS TO MEET FUTURE HUMAN NEEDS: PRODUCTION, PROCESSING, AND NUTRITIONAL QUALITY

Umaid Singh

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT),
Patancheru-502 324, India

Arid food crops (pulses and coarse grain cereals) are a key nutritional component of the human diet throughout the developing world. Large populations, with limited resources, will continue to depend on such crops in the foreseeable future, and demand will continue to rise. Although it is important to identify and develop genotypes with superior yield potential and nutritional value, it is equally important to improve processing and utilization techniques so as to increase the available nutritional value of existing genotypes. New and diverse food uses of crops (involving the agro-processing industry) will make for better nutrition, and also generate additional income for growers.

A1.10

CAN WE MEET THE NEEDS OF OILS AND FATS IN INDIA?

K.T. Achaya

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Till 1965, India was an oil surplus country. Thereafter, the three additive factors of population growth (2.1%), growth of per capita income (3.5%) and income elasticity for fat purchase (c. 1.0%) moved ahead of fat availablility. To maintain daily usage levels of 15-17 g per head, imports became necessary, rising to a figure of 18.2 lakh tonnes in 1983/84. Thereafter, a marked surge in oilseeds production to 180-190 lakh tonnes annually has caused a sharp drop in imports. High prices have, to some extent, offset income increase and cut into usage. The affluent 5% of the population consume 40% of the total oil used in India; reduced use of oil would benefit both their own health and that of the national economy.

Oilseed productivity in India has been rising slowly, especially where irrigation is available, but is still well below even world average levels. Newer sources like the cottonseed, rice bran, tree and forest oilseeds, and expeller oilcakes are contributing increasingly to the oil pool through solvent extraction. Oilseeds like the groundnut, rape-mustard and sunflower are now being grown both in the Kharif and Rabi seasons. Soyabean cultivation is expanding rapidly. Pilot projects, to grow the highly-productive perennial oil palm, are in operation in several states. The private sector is entering the oilseed production area.

The oilseed gap is thus being bridged by increased oilseed production, greater productivity, new growing strategies and harnessing new oil sources. Demand is rising inexorably, and could be significantly regulated, if the affluent were to reduce their excessive and harmful fat consumption. There is no need for undue pessimism in meeting future fat needs.

A1.19

PERSPECTIVES FOR COMBATING HUNGER IN DEVELOPING COUNTRIES

V.K. Nataraj

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Two dimensions of hunger need to be distinguished. One is chronic hunger which debilitates constantly and causes problems over a long period of time. The other is sudden traumatic hunger caused by massive shortages in food production. Both converge at one point. They are unified in their differential impact upon the population. Neither the persistence of the former nor the seeming suddenness of the latter affects all sections equally. Secondly, it is necessary to distinguish the problem of food in short supply from that of inability to command it. In the absence of these vital distinctions, the problem of hunger will lie only partially attended to with emphasis solely on production and the increase in numbers. This paper attempts to place hunger in a wider socio-economic perspective. It does so by linking hunger to the overall ethos of development.

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RESEARCH & DEVELOPMENT AND TECHNOLOGY TRANSFER

Venue : Assembly Hall

Wednesday, the 8th September, 1993

A2.06

FOOD RESEARCH AND DEVELOPMENT IN AFRICA STATUS AND THE APPROACH

A.O. Olorunda

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Export demands and the need for import substitution in pre- and post-independent African countries have always provided the stimulus for research and development (R&D) work in the formal and informal sectors of their food industry.

The formal sectors of the food industry are made up of multi-nationals with the parent company located outside Africa, while the informal sectors are largely traditional food processors/operators.

Until recently, most of the R & D efforts particularly in the formal sectors were carried out in the parent companies of multi-national food companies, while most of the local R & D efforts remain largely under-utilized. This situation is gradually changing as a result of several factors including the World Bank recommended structural adjustment programme.

The implications of these developments on the current status of food research and development in Africa and the possible approaches that would lead to a more sustainable growth of the food industry have been examined.

A3.01

ROLE OF AN INDUSTRIAL R&D ORGANIZATION IN A CHANGING ECONOMIC CLIMATE - A CASE STUDY

P.M. Jayatissa

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Colombo, Sri Lanka

Industrial development has been recognised as the best strategy for achieving rapid economic progress. Wtih Sri Lanka's new open economic policy, industries need to seek competitive advantage through product diversification and product quality. Technology is the key element in improving competitiveness of industry.

The CISIR was established in 1955 with the responsibility of carrying out R&D and providing technology support services to upgrade the technology base of the industry. Due to the protective economic policies which prevailed earlier and due to inherent weaknesses in the organisation, the CISIR concentrated mainly on in-house originated scientific research in the first three decades of existence. This effort did not yield any commercially viable industrial technologies or adequate technology support services.

To remedy this situation, the CISIR is restructured to transform itself to a demand-driven and market-oriented institution with improved self-financing ability. The CISIR will cater to the needs of industry in terms of feasibility studies, product and process development, design fabrication of equipment, diversification and quality upgrading of products and providing other technology support services. Adaptation of imported technology is another major area of activity.

The major part of CISIR activities is concentrated in the Agro-Food Technology area.

A2.08

ACTION RESEARCH AND TECHNOLOGY TRANSFER

Andrew Jones and Kithsiri Dharmapriya

Intermediate Technology Development Group,
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A tray drier was designed to meet the need for intermediate scale drying technology for herbs and other high value commodities in Guatemala. It can give controllable drying to produce high quality products at an affordable cost. The setting up of system costs 4 000. It can process up to 360 kg of fresh herbaceous material per 24 hours.

There were similar needs in Peru and local food technologists were trained in the construction and use of the tray drier. Now, there are 40 driers operating in Peru, 5 years after the first tray drier was set-up. They are being used for drying products ranging from herbs to fruit and employing over 200 people. The success of the tray drier in Latin America has motivated ITDG to promote the technology on a wide scale. The paper will describe user guides, construction manuals and construction videos and case study book to illustrate the process of technical transfer.

In Zimbabwe, the availability of cooking oil in rural areas is limited, erratic and often expensive. The cooking oil produced by large companies is marketed mostly in urban areas. As oilseed depots are situated in rural areas, an opportunity to investigate the potential of decentralised oil mills was created. Decentralised oil mills not only increase supplies of edible oil to rural communities, and in the long run, improve their nutritional status, but also create business and employment opportunities. The oilcake by-product also stimulates local poultry and cattle production. However government control of prices, raw material availability and marketing of the oilcake have been identified as potential risks.

The technology identified as appropriate for rural production was the Tiny Tech Oil Expeller from India. The system costs 3,000, requires a work force of 5 people and can process 250 tonnes per year of sunflower or groundnut. This system has been shown to be viable and a programme of promotion is now underway in Zimbabwe.

Technical transfer has to take into account that markets are competitive and that groups of poor people will have to learn new skills in marketing and business administration. Most importantly, poor people need to gain sufficient confidence to develop a successful business. Hence, technology transfer is more than the simple transfer of equipment - it is also the transfer through practical training and teaching of many aspects which help to build up the know why factor.

A3.02a

MANAGEMENT OF RESEARCH AND DEVELOPMENT IN INDUSTRIES

R.C. Chandan

3257 Rice Creek Road, New Brighton, MN 55112, USA

The article presents an overview of current practices and trends related to the role of technology in food business and organization of R and D and New Products Development in the United States. Since technology is expected to deliver a competitive advantage in the market place, R and D executes projects related to new product and process development, improvements and cost reduction in existing products and processes. Application of Total Quality Management principles is helpful in achieving the objectives. To accelerate innovation and achieve success in the market place, it is becoming increasingly apparent that multifunctional teams perform significantly better.

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AGRO-DEVELOPMENT

***Venue*: IFTTC Auditorium**

Wednesday, the 8th September, 1993

A1.12

AGRO-BUSINESS FOR DEVELOPMENT OF AGRICULTURE

Won-Kae Choi

Chinju National Agricultural and Forestry Technical College
150 Chilan-dong Chinju Gyong-Nam, 660-280 Korea

Agriculture is undergoing rapid and accelerating changes due to technological and scientific developments and improved methods of organization and management.

Agriculture today is a much more complex job in the present industrial society than it has been in the past-agronomic society. Agriculture - the primary industry is really a big business like the secondary industry (processing). Large investments coupled with closer margins between cost of production and selling price make it necessary for the farmer to know more about his business, if he is to allocate resources in order to get optimum returns to the capital and labour invested.

The farm business planning and analysis approach for teaching and training farm management to new farmers in Korea have been developed over a period of 15 years. This approach provides a realistic and logical procedure to help farm operators learn the pertinent facts about their farm business.

At present, agro-business for success in the business of farming has to consider the high value-added agricultural products such as post-harvest and food processing technologies.

A4.03

STATUS OF AGRO-FOOD INDUSTRIES IN TAIWAN

Robin Y. Chiou

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Chiayi, Taiwan 600 83

During the last decade, food markets in Taiwan have provided a superior environment for the development of food processing industry under several economic, social and policy conditions. The significant progress in economic advancement is primarily based on the improvement of agriculture. Agricultural production in Taiwan has maintained higher average growth rate than that of population. Steady expansion of agro-food industries has created benefits for both farmers and consumers. Taiwan's important agro-foods include rice, fruits, vegetables, livestock and fishery products. The rich variety of agricultural products is sufficient to sustain both domestic and overseas sales. The recent development and the current situation of agro-food industries in Taiwan have been reported and detailed issues are addressed on some unique products.

A1.23

MEETING THE CHALLENGE OF SMALL-SCALE FOOD PROCESSING INDUSTRIES IN DEVELOPING COUNTRIES

Vishaka Hedellage and Madhavi Ariya Bandhu

Intermediate Technology Development Group,
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Small scale food processing provides opportunities for disadvantaged groups (especially women) to generate income. This is because small scale food processing is appropriate, adaptable and profitable However, in many countries, large scale production is decimating the small scale sectors, thereby adversely affecting their rural economies. This can be seen, for example, in the displacement of millions of women from the rice processing sector in Bangladesh as a result of mechanisation. Why is this happening? One reason is the unfair trading relations: the small enterprises do not receive the same benefits as the large scale sector (e.g., access to credit, subsidies, tax breaks). Also, macro economic changes like market liberalisation are adversely affecting small enterprises.

This paper examines the changes that need to be made by different players in this sector. Small scale entrepreneurs need to adapt to changing markets by using new techniques especially in respect of packaging and marketing. Development organisations need to become more commercially oriented and professional in their approach. They need to concentrate more on the economic side of the activity, for example, feasibility studies, business plans, credit, quality control and marketing. Finally, in respect of the governments and policy makers - what policies will favour the small scale producers in rural areas and correct market imperfections? How can we enable the voices of the rural producers to be heard?

A4.06

OVERVIEW OF THE DEVELOPMENT OF FOOD INDUSTRY THROUGH THE LAST 10 YEARS IN EGYPT

Ferial M. Abu Salem [1] and M.A. Abd Allah[2]

[1] National Research Centre, Food Technology and Dairy Department, Gahrir St, Dokki
[2] Ain Shams University, Fac. of Agric., Food Sci. Department,
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The safety and/or assuring foodstuffs for human consumption is now one of the main important problems in the world.

Many conferences which had been set out, recommended and confirm the preparation of the foodstuffs in higher quality for the consumers.

From such point of views, food technology is considered to be one of the major as well as minor goals to which the developed and developing countries focus their attention, such trend is considered to develop the safety aspects and preservation techniques which matched with the nature of the different raw materials used in food processing.

A real development and reasonable achievements in food industries during the last ten years (1982-1992) in different types of food industry in Egypt will be discussed.

A1.24

RESOURCE-BASED ENTREPRENEURSHIP DEVELOPMENT OF SMALL TO MEDIUM-SCALE FOOD PROCESSING INDUSTRIES IN PAPUA NEW GUINEA

Alfred Ihekoronye

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PMB, LAE, Papua New Guinea

The perishable nature of domestic agricultural produce of Papua New Guinea introduces a dilemma; if food self-sufficiency is to be achieved, the country must reduce its high food import bills by processing the available raw agricultural produce into more nutritious and shelf-stable forms which people can readily buy from their urban and village stores. Food processing on an industrial scale is being encouraged, particularly in the small-scale sector where the role of the government is, in the main, related to providing facilitative and supportive machinery. To be an economically viable and sustainable venture, the enterprise should adopt technology for basic needs for raw material transformation. There are many instances of such food processing technologies developed in the ASEAN countries, which fulfil the features of basic needs. Information should be disseminated on sources through which such technologies could be available on a continuing and collaborative basis.

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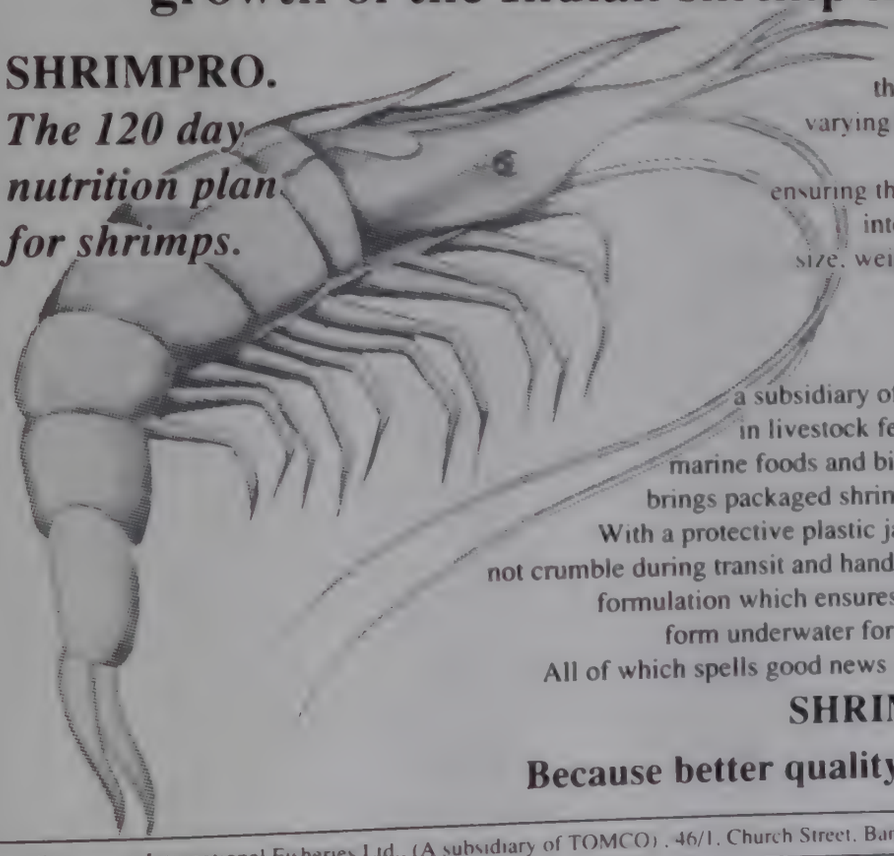

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EMERGING TECHNOLOGIES

***Venue*: Assembly Hall**

Wednesday, the 8th September, 1993

B2.14

HIGH PRESSURE TECHNOLOGY IN THE FOOD INDUSTRY

R. David Farr

Nestle Research Centre, Vers-chez-les-Blanc,
P.O. Box 44 CH, 1000 Lousanne 26, Switzerland

The effects of high hydrostatic pressure of up to 10.000 bar on the viability of microorganisms and on protein denaturation have been known for over 90 years. Renewed interest has recently been shown in use of high pressure technology in food processing, particularly in Japan, and more recently in Europe where high pressure machines are being developed for the food industry. In Japan a number of high pressure machines with capacities of up to 4.000 litres per hour have been installed. There is now a more optimistic attitude towards the potential use of this technology in the food industry. The present state of high pressure research in Japan and Europe will be discussed.

B2.10

MEMBRANE PROCESSES APPLIED TO FRUIT JUICES

Steve Morris

PCI Membrane Systems Ltd., Laverstoke Mill, Whitchurch,
Hampshire, RG28 7NR, England

The use of pressure driven membrane processes in the Fruit Juice Industry is now widespread. Membranes are being used to produce high quality juices with improved taste and colour, whilst reducing operating costs.

This paper gives a brief overview of Ultrafiltration and Reverse Osmosis technology and reviews the areas where it is applied in the field of fruit juice processing. It addresses the advantages associated with the use of membranes and describes some actual installations. It concludes by looking at future possibilities and developments for the use of membranes for fruit juice applications.

B2.12

AUSTRALIAN ADVANCES IN MEMBRANE PROCESSING OF FOODS

M H. Nguyen

Department of Food Science and Technology, University of Western Sydney,
Hawkesbury, Richmond Bourke St. NSW 2753, Australia

The paper will report on developments in the use of membrane technology for food processing in Australia. Although its population is small and its location is far from major world technological centres, Australia has achieved significant advances in this area. Specific examples are the microfiltration with gaseous backflush for clarification of juices, counter-diffusion membrane for desalting of whey and

soysauce and osmotic distillation membrane to concentrate grape juice to 70° Brix without the use of an evaporator.

B2.11

MEMBRANE PROCESSES FOR ALCOHOL-FREE AND LOW-ALCOHOL BEER PRODUCTION

I. Leskosek

Faculty of Agriculture, University of Belgrade,
11081 Belgrade, Nemonjina 6, Yugoslavia

Over the last few years, beers with reduced or zero alcohol content have made considerable breakthrough in the beer market. The reasons are numerous including changes in drinking habits, life style, health and driving problems. A variety of processes are available in current brewing practice, but the trend is towards separation processes which remove alcohol from conventional beers. Among them, membrane processes, reverse osmosis and dialysis are fairly new technologies and promising solutions. An overview of the state-of-the-art of this subject will be presented, including a discussion on the designed equipment, operating procedure, parameters influencing beer quality and application in other products.

B2.13

APPLICATION OF HURDLE-TECHNOLOGY TO FOODS OF INDUSTRIALIZED AND DEVELOPING COUNTRIES

Lothar Leistner

Federal Centre for Meat Research,
D-8650 Kulmbach, Germany

The microbial stability and sensory quality of most foods are based on the combination of several factors or hurdles (temperature, pH, a_w, Eh, competitive flora, preservatives, etc.). More than 30 hurdles employed in food preservation have hitherto been identified.

The hurdle-effect illustrates the combined effects of different factors for the stability and safety of foods. From the hurdle-effect, the hurdle-technology has been derived, which now is employed often, the industrialized as well as developing countries for the optimization or development of food products, especially those foods which are storable without refrigeration.

The application of hurdle-technology to food preservation is a fast moving field. The linkage of hurdle-technology (used in food design) with the HACCP concept (used in process control) has been achieved. The relationships of hurdle-technology to the homeostasis of microorganisms and the predictive modelling of foods are currently under study.

Hurdle-technology is applicable for quality aspects of foods too. The same hurdle could have a positive or a negative effect on food quality, depending on its intensity. In order to secure the total quality of a food, the safety and quality hurdles should be kept in the optimal range.

TRADITIONAL FOODS

Venue: Lecture Hall I

Wednesday, the 8th September, 1993

F3.13

TRADITIONAL MEAT PRODUCTS OF DEVELOPING COUNTRIES STORABLE WITHOUT REFRIGERATION

L. Leistner

Federal Centre for Meat Research, D-8650 Kulmbach, Germany

Meat products of developing countries which are stable and safe without refrigeration are traditional in Asia, Africa and Latin America. Most of these meats are Intermediate Moisture Foods (IMF), but some are Shelf Stable Products (SSP) with a much higher water activity and few are fermented. In general, the stability and quality of such foods are governed by several factors (hurdles). If the principles of the stability and quality are revealed and the hurdles are combined intelligently, by applying hurdle-technology, then traditional meats could be improved, and novel products created. For the process of each product, the critical control points should be defined, and thus hurdle-technology and the HACCP concept could be linked. Moreover, an exchange of knowledge between different regions of the world should stimulate creative thinking and would improve the best use of scarce resources of meat.

B1.08

ENGINEERING TRADITIONAL TECHNOLOGIES FOR COMMERCIAL PRODUCTION

R.P. Aneja

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Some 60 million tonnes of milk are annually processed by the organised sector in India. This is about 10% of the total milk produced in the country. Some 20 million tonnes of milk are however, converted into ghee at the farm level using the traditional methods. Also, some 10 million tonnes of milk are converted into traditional dairy products based on *khoa*, *channa*, *paneer* and other similar products. The traditional trade has created an immense market for such products at fairly high prices and very attractive returns. The organised dairy sector in India provides only a small amount of ghee produced in the country. Bulk of the ghee continues to be manufactured in the traditional way. The quality of ghee production in the traditional manner is generally considered to be superior to the dairy ghee. Technologies have now been developed to manufacture the traditional type of ghee on a large scale. The application of these technologies can result into substantial cost reduction and tremendous improvement in the quality of ghee manufactured by the organised dairy sector.

Technologies are also now available to manufacture of *khoa*, and *khoa*-based sweets on large scale. These technologies have been evolved by scanning the food technologies and processing equipment from all over the world and developing suitable technologies to produce traditional products. Such technologies are now available for the manufacture of *khoa*, *peda*, *burfee*, *gulabjamuns* and *shrikhand*. Technologies are also being developed for large scale manufacture of *paneer*, *channa*, *rasgulla* and *sandesh*. Traditional dairy products like *shrikhand* have already been manufactured on large scale. The returns on the manufacture of traditional dairy products are generally believed to be much higher than the returns on the manufacture of western types of dairy products like milk powder, butter, etc. There is a tremendous business opportunity in adopting modern technologies for the commercial production and marketing of traditional dairy products in India.

B1.07

DEVELOPMENT OF COMMERCIALLY VIABLE TECHNOLOGIES FOR SOME TRADITIONAL FOODS OF INDIA

H.S.R. Desikachar

2997/1, Kalidasa Road, Mysore 570 002, India

Roti/Chapathi and rice, the two staple traditional foods of India, are now prepared everyday in individual households and also whenever necessary. Ready-to-eat *Chapathi* and a quick cooking form of rice have to be produced and marketed commercially to suit modern urban requirements and for saving of time, labour and energy. While some scientific and technical information is available, feasibility studies are required. Production of pre cooked *Dhal* for mass consumption also deserves study.

Noodles from mixed cereals or a mixture of cereals and pulses can receive wide acceptance as a breakfast food. Both product formulation and consumer acceptance need to be studied. Technical aspects of production do not seem to present problems.

Several ready to-eat or ready mix formulations for sweets, savouries, soups, and spice mixes have been developed and widely produced. Improved product standardisation and enhanced shelf-life are essential to enable wider acceptance and realising export potential.

B1.14a

TRADITIONAL FERMENTED FOODS AND BEVERAGES OF NIGERIA AND AFRICAN COUNTRIES

A.V. Kuboye (Mrs)

Federal Institute of Industrial Research
Oshodi P.M.B. 21023, Vikeja, Lagos, Nigeria.

Traditional methods of processing fermented foods and beverages of Nigeria and other African Countries have been enumerated. The microorganisms responsible for fermentation have been isolated and identified; they have been found to be endogenous microflora present in the raw materials, Lactic and acetic acids produced during the course of fermentation act as preservatives. The production processes of these foods are currently being improved by development of starter cultures containing microorganisms with improved fermentation characteristics. Products of better quality and longer shelf-life have been obtained as a result of improvement in process technology

B1.16

NEED FOR MODERNIZATION OF THE TRADITIONAL FRUIT AND VEGETABLE PRESERVE (*MURABBA*) AND CANDY INDUSTRY IN INDIA

J.S. Pruthi

HIG Duplex G-28, Pratap Vihar, Sector XI,
Ghaziabad (NCT) 201009, India

This presentation covers the economic importance and peeps into the history of the Indian fruit and vegetable preserve (Murabba) industry. It provides glimpses of the present scenario and the pharmaceutical/nutritive value of Indian Murabbas as well as candies. The author draws upon his critical appraisal of the developments in the area during his recent visits to Australia, China and Hong Kong, the major producers of ginger preserve and confections. For the benefit of the Indian industry, the highlights of the latest R&D, notably in Australia, have been covered to some extent on the following aspects: (a) horticultural aspects - development of new varieties suitable for processing; (b) new technologies in curing and processing, including continuous processing; (c) quality control, grades and packs; and (d) microbiology. R&D programmes have been suggested for developing the present cottage scale Indian preserve industry into a dynamic Modern Food Industry of India.

B1.04

THERMAL PROCESSING OF ACID FERMENTED VEGETABLES

Aslan Azizi[1] and S. Ranganna[2]

[1] Agricultural Engineering Research Institute,
Agricultural Research Organisation, Evin-Tehran, I.R. Iran.
[2] 63, Ashram Road, Jayalakshmipuram, Mysore-570 012, India

Fermentation is a process of bringing forth desirble biochemical changes in foods by microorganisms or enzymes. The end product of a fermentation process is either lactic acid or acetic acid or ethanol brought forth by bacteria or yeast. Natural fermentation of vegetables in brine evolves lactic acid due to the activity of lactic acid bacteria. This reduces the pH of the vegetable below 4.6, which inhibits the growth of high heat resistant-spore forming organisms, particularly the toxigenic *Clostridium botulinum*, thereby cutting down the heat required to process the food, while improving the food quality. This process usually takes about a week and can be speeded up by adding 2% hot brine to cover the prepared vegetable to reduce the pH to 3.8 in three days. Another method of reducing the pH is by addition of acids. Malic acid for canned vegetables in brine and glucono delta lactone for curried vegetables were found to be best for the two products, respectively. *B. coagulans* and *B. licheniformis* were used as index organisms in foods below pH 4.0 and a sterilising value of $F^{8.9}_{100} = 3.5$ obtained to render the canned foods microbiologically safe. Lactic fermented vegetables were found superior in colour, texture and flavour as compared to acidified vegetables.

B1.20

TRADITIONAL FOOD PRODUCTS - THE WAY AHEAD

Mike Batcock

Intermediate Technology Development Group, House-32, Road 13A,
Dhanamondi, RA, Dhaka 1209, Bangladesh

The rural poor have always used traditional techniques for preserving food, mostly for home consumption. These techniques have been used to preserve food for the off-season, when food is not readily available and to obtain products for local sales. These techniques were developed through years

of trial and error (i.e., research and development). The traditional food products are now being replaced by mass produced items. Not only is this concentrating the means of production into the hands of a few but also the vast store of knowledge about traditional technologies is being lost by the rural poor. Examples will be given from Sri Lanka and Bangladesh.

What can be done? If traditional products are to survive, their production needs to change. In many cases, the scale of production needs to be increased: from domestic level preparations for home consumption to small scale commercial food processing. These traditional technologies need to be integrated with emerging technologies. For instance, quality control procedures need to be included in the process cycle; appropriate packaging technologies need to be used to compete in the markets and marketing must be more sophisticated. In Sri Lanka, work has been carried out with small scale food processors to identify traditional technologies which can be developed for competing in the markets. Successes and failures from Sri Lanka, Bangladesh and India will be used to illustrate this point.

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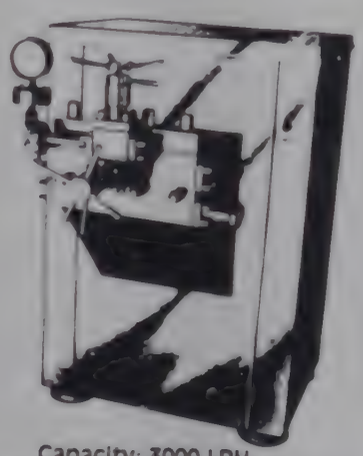

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FOOD GRAINS - WHEAT

***Venue*: Silver Jubilee Hall**

Wednesday, the 8th September, 1993

F1.13

CRITICAL APPRAISAL OF QUALITY REQUIREMENTS OF MILLED PRODUCTS OF WHEAT FOR INDIGENOUS FOODS

P. Haridas Rao

Milling and Baking Technology Department,
Central Food Technological Research Institute, Mysore-570 013, India

Large part of wheat grown in India is primarily used in the preparation of various traditional products like *chapati, roti, phulka, parotha, poori, nan, upmav* etc. Also, it is used in the preparation of many indigenous sweet and savoury products. Whole wheat flour obtained after milling wheat in *chakki* or disc mill, and *resultant atta*, obtained as a by-product of roller flour mill, form the main raw materials for the preparation of most of the traditional foods. Refined wheat flour and semolina form the raw materials in the preparation various other traditional and confectionery products such as *Sohan haluva, Sohan papdi, Jilebi, Chiroti* etc. These products vary in processing conditons resulting in unique textural and taste profiles. The quality requirements of raw materials for the preparation of different products vary significantly.

For the preparation of *chapati*, and its variants such as *roti, phulka, parotha*, wheat ground in disc mill of metallic or stone discs has been found to be better suited than that ground in other types of mills such as pin mill, hammer mill, roller mill etc. Among the types of wheat, medium hard wheat containing 9-10% gluten protein, 14-15% damaged starch, is more suitable for the preparation of *chapati* and *roti*. *phulka* in addition to these requirements, needs a flour of much finer granulation. *Resultant atta* is not well suited for obtaining good *chapati* as it has lower damaged starch content. *Poori* is a deep-fat fried product and requires flour with lower bran content to enable the product to puff fully during frying.

Refined flour, from roller flour mills, with low ash (0.4-0.5%) and medium protein content (9-10%), is preferred in the preparation of other traditional products like *nan* and South Indian *parotha*. A dough of good extensibility is a desirable characteristic for the preparation of *parotha*. This enables the stretching of the dough into a thin sheet needed for layering.

The available information on the quality requirements indicates the urgent need to collect the exhaustive scientific data regarding quality requirement of milled products of wheat for the preparation of various indigenous products which would go a long away in making available the desired quality flour for different indigenous products.

F1.17

RESEARCH AND DEVELOPMENT IN TRADITIONAL WHEAT PRODUCTS

Hamed Faridi[1] and Jalal Qarooni[2]

[1] Nabisco Foods Group, 200 DeForest Ave.,
East Hanover, P.O. Box No.1944, NJ 07936, USA

[2] Department of Grain Science and Industry,
Kansas State University, Manhattan, KS 66506, USA

For the past three decades, research and development efforts had been focussed on developing an improved understanding of wheat flour functionality, standardization of traditional production processes, and specifying objectively the attributes of traditional finished products. The spectrum of traditional wheat products around the world and the status of research and development of them will be reviewed and discussed.

F1.14

FLOUR MIX FOR BAKERY PRODUCTS

C.P. Menon

Britannia Industries Limited, R & D Centre, India
M.T.H. Road, Padi, Madras-600 050

Wheat grain as a staple food originated with the civilizations and it has today emerged as the most popular cereal food of the world. Developments of various types of products based on wheat grain/flour contributed to the present day bakery products. This is by making use of the properties of wheat proteins in forming gluten and its ability to withstand machining and processing conditions. Other cereals and pulses also became popular with populations of the world and were used in various forms as processed foods. Some of them, although have process conditions like baking, are not considered as bakery products. Many traditional foods using different admixtures of leguminous and cereal flours are commercial successes as processed foods. Present day research attempts to blend the goodness of these traditional foods into bakery technology by incorporating mixture of cereal and pulse flours and processing them in the conventional baking process. This resulted in a wide variety of products of traditional tastes, with locally available cereal flour blends made by the baking process conventionally followed for bread or biscuit manufacture.

FOOD GRAIN PROCESSING - RICE, COARSE GRAINS AND LEGUMES

Venue: Lecture Hall II

Wednesday, the 8th September, 1993

F1.09a

INTRODUCTION TO RICE PROCESSING COMPLEX (RPC) AS A NEW POST-HARVEST SYSTEM OF RICE FOR SMALL FARMS

D.C. Kim[1] and T.W. Kwon[2]

[1] Korea Food Research Institute,
Songnam, Kyongii-do, Korea

[2] Food Science Institute, Inge University, 18-3 Aobang-dong, Kimhae, Kyongsangnam-do, Korea

During the course of fast growing country like Korea, many technical changes and adjustments among other parameters are inevitable in order to meet new requirements in the transition phase. As an example, the post-harvest technology of rice can be cited. Rice represents the staple crop and the most important agricultural product in Korea. Unfortunately, however, there are still considerable losses both in quantity and quality after harvest. In addition, there are severe labour shortages in farming areas and increasing demands for high quality rice in the markets.

To solve such complex problem, we developed in-bin drying and storage (IBDS) system to dry and store 3 tonnes of wet peddy rice in bulk and such bins are widely installed throughout Korea. Further developments on this system now made us possible to scale up to 1,200 tonnes and to convert into the no-wash rice. Now IBDS-RPC combined system is in the process of active dissemination as the new post-harvest system for rice.

F1.06

INDUSTRIAL DEVELOPMENT IN MILLING OF RICE

P.P. Pillaiyar

Paddy Processing Research Centre
Thanjavur-613 005, India

A variety of indigenous milling equipments, such as pestle and mortar and stone chakkies were in use from time immemorial. The invention of Engelberg huller revolutionized the rice milling industry. However, the high friction of metal roll causes undue breakage, particularly in raw rice. Further, the husk and bran get mixed up. To overcome these defects, separate machines for dehusking and whitening were developed. Auxiliary equipments for getting a cleaner product and value-added by-products were then introduced. Special facilities like brown rice conditioner, refining unit for producing germ-retained rice and humidified friction whitening with automatic brightness controller are now in use. To suit the operating level of custom-huller units, single pass compact mini mills with rubber husker and friction type whitener were developed; but their cost deterred wide adoption. Subsequently, compact mills with Engelberg huller as whitener, particularly for parboiled rice milling situation was introduced. Side by side, attempts were made to improve the performance of the huller by effecting changes in its operating conditions and modifying certain components.

F1.10

PROCESSING OF COARSE CEREALS FOR FOOD AND INDUSTRIAL USES

N.G. Malleshi

Department of Grain Science and Technology,
Central Food Technological Research Institute, Mysore-570 013, India

Maize, sorghum, oats, rye and millets are considered as coarse cereals. Their annual production is about 550 and 30 mmt in world and India, respectively. They form staple food for a large segment of population in developing countries, and feed and industrial raw materials in developed countries. Slow digestibility of their carbohydrates combined with a good source of dietary fibre, vitamins and minerals qualify them for preparation of health foods. Maize milling is done on industrial scale for food, feed and starch. Maize germ oil is a valuable by-product of milling industry. Small scale milling machinery for maize, sorghum and millets have been developed but still customary milling is extensively practised in India and Africa. Composite flours based on coarse cereals and wheat find place in bakery. The oil-rich bran from millets could be used as extenders of rice bran for oil extraction and deoiled bran as a good source of dietary fibre. Among the coarse cereals, sorghum and finger millet are poised for malting and brewing. Besides brewing, their malts form cereal bases of nutritious and low dietary bulk weaning and supplementary foods. By way of popping and flaking, maize, sorghum and millets could find usage as diversified products. However, improvement in popping process, avoiding sand medium is the need of the hour. Adaptation of extrusion cooking technology for preparation of traditional snacks, value, added products and nutritious foods for local consumption and mass feeding programmes may be very remunerative. The coarse cereals, being major protein and energy sources for the economically weaker sections of the population of the developing countries, deserve application of modern pre-harvest and post-harvest technology for improving their nutritional and processing qualities.

FOOD ADJUNCTS AND ADDITIVES

Venue: Lecture Hall III

Wednesday, the 8th September, 1993

F7.08

STARCH TO ALCOHOL: A CASE STUDY AND ITS ECONOMICS

Ashok Pandey

Regional Research Laboratory, Council of Scientific and Industrial Research
Trivandrum-695 019, India

Alcohol (ethanol) traditionally has been produced from molasses all over the world. Starch containing crops, however, are also good sources of carbohydrates for the production of alcohol. Among the various such sources, cassava constitutes an attractive possibility to be used as substrate. This paper describes the scope of utilizing this tuber crop for the manufacture of alcohol which is readily available in tropical regions. Economics of the process is also discussed.

F7.07

BREWING INDUSTRY IN INDIA

S. Cariappa, V.S. Ravichandran and R.R. Ashok

Mysore Breweries Ltd., Post Box No. 2211,
Jalahalli Camp Road, Yeshwanthpur, Bangalore-560 022, India

The Brewing Industry in India is reviewed. The availability of raw materials like Barley, Malt, Hops etc., and their use in the brewing are explained in detail. The specific areas of modernisation of process technology like wort separation, wort boiling, fermentation and filtration are indicated. Packaging which has now gained significance due to its high growth rate in the Indian market, is also discussed.

F8.01

NATURAL FOOD COLOURS - WHERE WE STAND

P.J. Dubash

University Department of Chemical Technology, Bombay, India

We have been accustomed to food colours right from pre-historic times and these have been consumed safely for generations. However, during the processing of foods in today's food industry, the natural food colours are sometimes lost or degraded. In other types of foods like synthetic and carbonated soft drinks, confectionery and dairy products, food colours need to be added to make them attractive and acceptable.

Synthetic coal tar dyes were used freely at one time, but one by one, these have become suspect - many of them are carcinogenic and are being gradually withdrawn.

Today's technology has provided us with natural and nature-identical food colours. Although it is a widespread belief that natural food colours do not perform as well as synthetic food colours, the fact is that natural sources can provide a comprehensive range of attractive hues and can be used to colour many types of foods.

Natural food colourants are obtained from spices like turmeric, paprika and saffron and others like annatto, beet colourants, enocyanins, carmine and monascus pigments. These find widespread applicability in modern food industry. The factors affecting stability in usage will be discussed.

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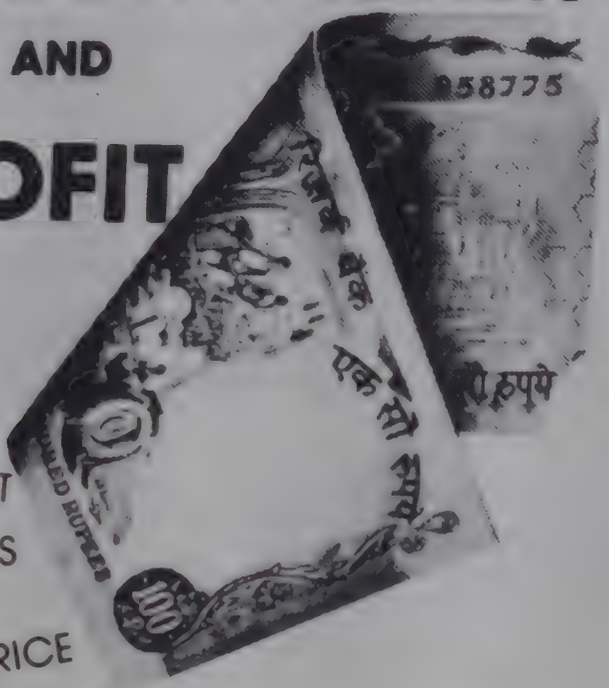

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TEA SALT
SPICES
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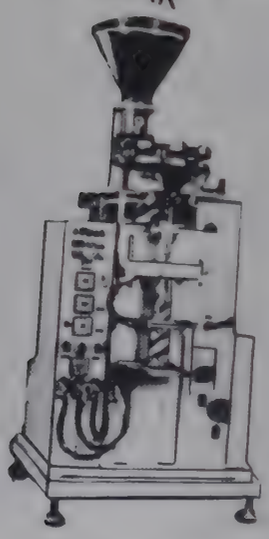
SUGAR RICE



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IMPULSE/93

CONVENIENCE AND SPECIALITY FOODS

Venue: IFTTC Auditorium

Thursday, the 9th September, 1993

E1.09

CATERING THE DEFENCE FORCES DURING PEACE TIME, IN FORWARD AREAS AND WAR FRONTS - CURRENT TRENDS AND FUTURE PERSPECTIVES

V.S. Joshi

Directorate-General of Supplies and Transport,
QMG's Branch (ST-7&8), DHQ, PO New Delhi-110 011, India

Catering the Defence Forces to keep them fighting fit is itself a big challenge to a country like India. It was only in World War II that Indian Troops were first placed on Basic Ration Scales to provide balanced diet. The principles involved in feeding our forces are to provide rations in kind, not in cash, variety and flexibility of items/substitutes with more emphasis on fresh rations. To-day, we have well defined system of catering the Defence Forces. Well defined scale of rations, catering arrangement and specified types of rations have been catered to meet any eventuality. We have a Catering Cell at each Command HQ under charge of an officer who coordinates on all matters concerning rations, supply position and catering in their respective services. With rapid advancement in the food industry and food technology, a lot of progress in collaboration with various food manufacturing units is already on to develop foods which are nutritious, tasty, acceptable, convenient to cook and are economical too.

E2.05

CRITERIA FOR THE DEVELOPMENT OF SPACE FOODS AND THEIR ACCEPTABILITY

D. Vijaya Rao

Defence Food Research Laboratory, Mysore-570 011, India

Designing a food system goes with the territory. The criteria for selecting space foods and their packaging and delivery systems have depended on the type, construction and life support systems of the space transport vehicles that have been used and the objectives and duration of the manned space missions. Progressing from the bite-size foods for a single person and "Squeeze tube" pureed foods of the 60's resembling the military type survival rations for 1 or 2 persons, the foods for astronauts have undergone nutritional, organoleptic and technological refinements of such proportions that by the 80's, it was possible to feed a 7 man crew in space shuttles with the choicest of foods for a week (mostly rehydratable) or sustain a crew of 3 or 4 in space station undergoing endurance tests with both rehydratable and some fresh foods on periodic resupply. For the permanently manned space station of the 90's, dehydrated foods take a low priority compared to microwaveable frozen foods, retorted foods and even fresh chilled ones.

Apart from the most important criterion of total microbiological safety and high quality, other important considerations e.g., nutritional requirements, weight and volume constraints, functionality of the packaging materials and the food container, availability of water on board along with heating and chilling conveniences, storage stability of the foods under the storage and handling conditions in the spacecraft, disposal mechanisms, resupply costs, and f course, the crew's preferences and motivation have determined what foods and which technologies will be suitable.

Foods for future missions are expected to be produced on space stations in a closed ecological life support system which is compatible with the environment of the space station.

E2.02

CONVENIENCE FOODS FOR STRATEGIC SITUATIONS

S.S. Arya

Defence Food Research Laboratory, Mysore-570 011, India

In India, developments in convenience foods have taken place mainly during the last three decades. Products like Gulab Jamun, cake and ice-cream mixes have emerged from consumer's desire to prepare them in homes. Other products (which are staple in Indian diet) like instant *Pulav*, *Khichdi*, *Dhal curry*, *Upma*, *Halwa* and *Idli* mixes and long life ready-made *Chapati*, *Paroṭha*, *Alu-chholay* and Peas-*paneer* curry have been developed specifically to meet the demands of armed forces for operational pack rations.

Among the various food processing operations, dehydration has found maximum use in the development of convenience products. Use of enzymes, soaking in sugar and salt solution, flaking and high temperature short time drying have been used to impart instant cooking characteristics to cereals, pulses and vegetables. For drying fruit juices and pulps, freeze-drying has emerged as the most suitable process. Freeze-drying has also been utilized for preparing quick cooking meals for astronauts and mountaineers. Frozen convenience foods have not been used on a large scale in troop feeding except for a small quantity of frozen meat supply to troops in north-western sector. Progress has been made in designing self-contained pack rations for troops and expeditions. Progress has also been made in designing pack rations which help in distribution and utilization by troops. Prominent among them are one-man composite pack ration and emergency and survival rations. Various constraints in the manufacture, marketing and use of convenience foods will be discussed.

E3.01

NEED FOR GERIATRIC FOODS - THE TECHNOLOGICAL CHALLENGE TO FOOD INDUSTRY

A.V. Rao

Department of Nutritional Sciences, Faculty of Medicine,
University of Toronto, Toronto, Ontario, Canada.

Recent advances in health care have resulted in dramatic increases in the number of elderly people in the population. This has brought with it a special set of problems and challenges in dealing with the nutritional and dietary needs of the geriatric population. Changes in the psycho-social domain and in physiology of elderly including social interactions, disease patterns, and nutrient intakes identify them as being unique and having specific needs. A major area of geriatric health involves the gastrointestinal function. The ecological patterns of intestinal microflora alter significantly with age. This, in turn, leads to increased incidence of pathogenic inflictions, constipation, cancer and disorders in liver function. There is considerable interest around the world to develop foods that are particularly suited for consumption by the elderly. However, several innovative technologies have to be developed by the food industry to meet this challenge. Above all, through this approach, the overall quality of life of the elderly population can be improved.

E6.17

FOOD PRODUCTS FOR DIFFERENT AGE GROUPS: SCOPE FOR DEVELOPMENT AND PRODUCTION IN INDIA

S. Venkat Rao

Central Food Techological Research Institute,
Mysore-570 013, India

In recent years, significant progress has been made in our country in the area of development of food products for meeting the nutritional needs of the population. The market for these foods is rapidly expanding in the country. These food products may be broadly categorised as foods formulated to meet the deficiency states in various age groups such as infants, children, pregnant and nursing mothers and geriatrics. These foods are required to be fed for prolonged periods and hence they should resemble normal foods in appearence and acceptability. The food industry has a special role to play in meeting this need. India has a large potential in this area and there is scope for marketing such products inside as well as outside the country.

E1.03

INFLIGHT CATERING SERVICES

J.S. Sethi

Taj Air Caterers, New Delhi, India

Inflight catering although by now an old industry has still not gained as much awareness and attention as the other catering industries. Comparing to other catering industries, the inflight Catering Industry is more factory-like but has a host of in-built contradictions. Speaking strictly in terms of food technology, the areas of prime concern to our industry are hygiene, authenticity of cuisine, presenting wholsome meals and time constraints.

Hygiene standards to be maintained in our industry are most stringent as one can imagine the perils of a food poisoned passenger at 35,000 ft. Hygiene stndards are maintained right from the procurement of material till the meals are served to the passengers. The various types of meals/menus catered to in a day necessitate a variety of raw materials which need to be sanitized using different procedures.

Storage systems are developed to: prevent cross contamination of foods which are in different stages of production; control microbiological growth; and ensure safe transportation of prepared food to the aircraft.

Meal constituents are so far, given a lot of importance in terms of their storage and reheating capability and food value. With a growing demand for health foods, the airlines are very specific on the quantity and type of food uplifted. Of late, the order for special meals like diabetic meals etc. is growing. However, the deciding factor on quantity and type of food does not remain with the caterer but more on the time schedule of the flight, its destination and the profile of the clients.

To sum up the Inflight Service Industry, unlike other catering industries has an environment like that of a factory. However, unlike a factory only a limited amount of standardization can be built into its systems due to the highly varied output it generates.

E1.05

HOTELS CATERING TO COMMON MAN

A.S. Kamat

'Kamat Yatri Nivas', No.4, I Cross, Gandhi Nagar, Bangalore-560 009, India

Food technology for health and prosperity can be considered as the theme of this paper. If we go back to history, food and feeding were worshipped, attaching an element of sanctity. People used to take bath, wear clean clothes and eat cooked food with utmost care to hygiene. Food was consumed in a clean atmosphere after prayers and offering it to God. This was the practice in every cultured home, public gatherings in temples and social functions. Probably, we had much lesser health problems during those days when such practices relating to food were in vogue. Modernisation loses its meaning, if we cannot continue the age-old good practices. It is wrong to attach religious stigma to such practices and reject them, while blindly imitating alien practices in the name of modernisation. We used to eat food in privacy and answer calls of nature always mindful of sanitation. Now, not only do we eat in roadsides, but also impair their cleanliness by insanitary habits. Should we have any hesitation to accept this naked truth? and can we say it has no relation to hygiene and the health of the population?

E1.04

MASS FEEDING PROGRAMMES - A CONSPECTUS

Sreemathi Hariprasad

Central Food Technological Research Institute, Mysore-570 013, India

Feeding programmes, several of them supplementary, have been specifically targetted to serve the needs of under-privileged socio-economic groups in India. *Ad-hoc* feeding programmes for the general public during the emergencies, resulting from war, civil disasters, earthquakes and floods have also been reported and documented.

Mass feeding programmes have been a tradition of yore in India. Feeding of hundreds/thousands of individuals per day calls for tremendous coordinated efforts by way of planning commodity procurement of food items for a specific number of persons, preliminary processing and cooking, provision of basic nutrition (at least the essential carbohydrate component), maintenance of sanitation and hygiene, energy management, labour deployment, supervision and feedback; overall economy and the motivation/background are also major facets of such feeding programmes. An attempt will be made to present and discuss some case studies based on such feeding programmes.

BIOTECHNOLOGY

***Venue*: Assembly Hall**

Thursday, the 9th September, 1993

B3.05

A STEP TOWARDS DEVELOPING TRANSGENIC PLANTS WITH HIGH NUTRITIONAL QUALITY

Anuradha Mehta, K. Natarajan, Anjana Raina and Asis Datta

Molelcular Biology Laboratory, School of life Sciences,
Jawaharlal Nehru University, New Delhi-110 067, India

Isolation of two novel genes which are relevant to human health will be discussed in the lecture.

Some green leafy vegetables (e.g., Amaranthus, spinach, rhubarb) are rich sources of vitamins and minerals, but they contain oxalic acid as a nutritional stress factor. Such plants, when consumed in large amounts, become toxic to humans because oxalate chelates calcium and precipitation of calcium oxalate in the kidney leads to hyperoxaluria and destruction of renal tissues. Apart from this, at least two other instances can be cited where oxalic acid is involved in an indirect manner. In one case, the production of oxalic acid is an important attacking mechanism utilized by *Whetzelinia sclerotiorium*, a fungus that causes serious damage to crops like sunflower. In another case, consumption of Khesari dhal (*Lathyrus sativus*) causes neurolathyrism, which is characterized by spasticity of leg muscles, lower limb paralysis, convulsions, and death. It is a protein-rich hardy legume that grows under extreme conditons such as drought and water-logging and does not require complex management practices. The neurotoxin B-N-oxalyl-L- , -diaminopropionic acid (ODAP) is present in various parts of the plant. ODAP synthesis is a two-step reaction in which oxalic acid is an essential starting substrate. ODAP acts as a metabolic antagonist of glutamic acid, which is involved in transmission of nerve impulses in the brain. Hence, despite its rich protein content, the legume cannot be used as a food source.

Thus, the isolation of decarboxylase gene will serve as a tool to degrade oxalic acid in plants where oxalic acid accumulates as such or is a substrate in the synthesis of neurotoxin or is a medium for pathogenesis. This can be achieved by effecting a single gene character to these plants. In this context, the cloning and characterization of a novel gene, oxalate decarboxylase will be discussed.

Seed storage proteins form an important source of dietary protein for human beings. A balanced composition of amino acids is required in the human diet, but most often seeds are deficient in one or other of the essential amino acids. For example, cereals (rice, wheat, maize etc.) are very low in lysine, whereas in legumes (peas, etc.) sulphur-containing amino acids are low. For years, plant breeders have tried to improve the balance of essential amino acids of the important crop plants, but without much success. An alternative molecular approach will, therefore, be to express a seed-specific gene, encoding a heterologous protein with a balanced amino acid composition. Until now, this type of gene coding for a seed-specific protein with a high level of all essential amino acids was not known. A gene from Amaranthus that encodes a seed-specific protein rich in all essential amino acids including lysine and the E-amino acid has been isolated. Interestingly, the amino acid composition of this protein corresponds closely to that of the WHO recommended protein standard for optimum human nutrition. The gene encoding this protein has potential for compensating the amino acid deficiencies of many seed proteins once it is genetically engineered into target plants.

F7.06

DETOXIFICATION OF TOXIC METABOLITES GENERATED IN CELLS

Akira Kimura and Yoshiharu Inoue

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Methylglyoxal (MG) is a toxic substance which is produced from dihydroxyacetone phosphate, one of the metabolites of glycolysis. MG is synthesized in all cells from microbes to human beings. MG seems to inhibit uncontrolled growth of cells (cancer). MG is detoxified in the presence of glutathione (GSH) and converted to S-lactoylglutathione. This reaction is catalysed by an enzyme called glyoxalase I (Glo I).

We have found 3 other pathways. In the 2nd pathway, MG is reduced to lactaldehyde by MG-reductase. In the 3rd pathway, MG is directly converted to pyruvate. In the 4th pathway, MG is reduced into acetol.

Using MG resistant gene, we have bred a jumbo yeast cell, which has a 2-fold increase in diameter over the control (*Saccharomyces cerevisiae*), therefore, 8 times the cubic volume. The Glo I gene was cloned from *Pseudomonas putida*, and *S. cerevisiae*. The tertiary structure of glutathione synthetase of *Escherichia coli* B was completely determined by X-ray analysis.

B3.01

BIOTECHNOLOGICAL APPROACHES TO FRUIT AND VEGETABLES

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By the turn of 1992, over 40 species of Recombinant DNA-modified food and fibre crops have been described and field-tests of these 'designer plants' are under way in 20 countries the world over. The significance and urgency of the impact biotechnology will have on horticulture, especially fruit and vegetable crops, therefore, can hardly be over-emphasized. Mass propagation of superior-quality plants through tissue culture has already demonstrated spin-offs for horticulture and plantation crops. In fact, breakthroughs in tissue culture, in the decades past spawned an over-increasing number of biotechnologies anther/embryo/endosperm culture, somatic mutation, secondary-metabolite production, to name only a few. Integration of newer approaches such as transformation using *Agrobacterium*, electroporation, microprojectiles, somatic hybridization, antisense RNA etc. makes possibilities even more exciting in fruit and vegetable crops given in vast array of growth habit, this class of foods is endowed with.

B3.11

BIOMASS CONVERSION FOR EFFECTIVE UTILIZATION OF FOOD RESOURCES

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Biomass conversion of organic wastes for feed or human consumption still remains as hygienic, legal, egislative and economic problems. Five items of effective utilization of food resources are proposed. 1. If picked fish meat was used for fish cake industry (890,000 t, '91) instead of SURIMI, some 27,700 t of fish meat could be saved. 2. Genetic selection on livestock and gentle treatment in slaughterhouses will raise the amount of meat and meat quality for human consumption. 3. Biomass conversion ratio (wt. of fish/wt. of feed, fresh fish) in marine culture was estimated as low as 9.2% (yellowtail, '88-'89) and 6.4% (sea bream, '88). 4. About 4,600 t of fresh pork loin and ham for cooked meat products (104,500 t, '91) would be recovered from defect of Pale Soft Exudative (PSE) meat by emulsion curing. 5. By-product (viscera and head meat) utilization was only 31.8% (cattle) and 45.2% (hog) in 1988. Thus, the rate of biomass conversion should be reconsidered from effective utilization of food resources.

B3.07

GENETICALLY ENGINEERED FOOD ENZYMES

Richard Joseph

Department of Microbiology and Bioengineering,
Central Food Technological Research Institute, Mysore-570013, India

Enzyme technology in food applications is emerging as a major commercial enterprise. Not only are new catalytic functions employed, but also novel, tailor-made enzymes (including the semi-synthetic ones) are generated for specific process needs, employing the principles of organic chemistry and molecular genetics. Traditionally, the food processing enzymes have been hydrolases employed in starch, dairy, fruit, brewing and wine industries. Future application of enzymes would be for a wide range of processes to control texture, improve extraction, enhance separation, develop functionality, release nutrients, generate flavours and aromas, cause bioconversion or remove undesirable components. To achieve such functions optimally and economically, enzymes will have to be modified. The techniques and options available, some examples of successes achieved and future possibilities will be discussed.

B3.13

FUTURE TRENDS IN PLANT TISSUE AND CELL CULTURE

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Central Food Technological Research Institute, Mysore-570 013, India

In vitro propagation of floricultural and horticultural plants has been the major application of a large number of biotechnology companies. At least 30 biotechnology companies in India are engaged in micropropagation of banana, cardamom, sugarcane, vanilla, papaya, tomato and several horticultural crops. India has pioneered in the propagation of tree species like *Eucalyptus*, teak, sandalwood, *Populus*, *Dalbergia*, *Leuceana*. *In vitro* flowering of bamboo achieved for the first time in India has received world acclaim.

In the area of plant improvement through *in vitro* techniques, enriching of nutritional value of cereals, elimination of anti-nutritional factors like removal of toxic amino acids in *Kesari dhal* needs mention. Use of haploids in rice and wheat has contributed to increased productivity.

Plant cell culture to exploit chemical totipotency is on the verge of significant breakthrough in the field of food additives and pharmaceuticals in the near future. Food colours, flavours and sweeteners by cell cultures are preferred globally. Highly priced colours like anthocyanins, crocin and crocetins and flavours like safranal from saffron and vanilla are likely to go commercial. Capsaicin, the pungent flavour and food additive can be produced by immobilized *Capsicum* cells in column reactors. Madder colourants from *Rubia tinctorum* is now produced by hairy root cultures. Gene for thaumatin, a non-nutritive sweetener has now been successfully cloned into yeast for large scale production.

F6.42

PERFORMANCE OF TISSUE CULTURE PLANTS IN FIELD CONDITIONS - SMALL CARDAMOM

R. Naidu, J. Premkumar, M.R. Sudardashan, P. Natarajan and M. Narayana swamy

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The performance of one hundred and eleven high yielding clones of cardamom multiplied through micropropagation was evaluated against their open pollinated seedlings at 133 locations by planting in an area of 102.5 ha spread over the entire cardamom growing tracts in India. Biometric observations on growth and yield parameters revealed an overall superiority of the tissue cultured plants over their open pollinated seedlings by showing an increase of upto 17 per cent tiller production and 36 per cent increase in yield. However, the differences in the performance of various clones in different agroclimatic zones revealed the need for location specific clones. Yield variations in the performance of same clone in different estates of same agroclimatic zones revealed the importance of management in realization of higher yields. This paper discusses the performance of the tissue culture clones of cardamom in farmers' field conditions along with the future strategies for commercial use of the tissue culture technology in cardamom.

B3.15

MICROBIAL POLYSACCHARIDES AND THEIR COMMERCIAL FEASIBILITY AS COMPARED TO PLANT POLYSACCHARIDES

M.S. Prasad

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Microbial polysaccharides are gradually replacing the plant polysaccharides in several applications because of their consistency in quality and favourable functional properties. Incorporation of small quantities of polysaccharides, gums or hydrocolloids will improve the appearance, consistency, dispersion, storage and overall acceptability of the product. The choice of the polysaccharides either in food, pharmaceuticals, agriculture, textiles, ceramics, paper or in oil industries will depend on many factors, main being economic feasibility. In food systems, polysaccharides are employed to improve processing performance, and the stability, texture and appearance of the final product. But the basic structure/function relationship, interactions between molecules, molecules to food components are very essential before making the right choice. Microbial polysaccharides have an edge over plant polysaccharides except in

terms of cost. The range of microbial polysaccharides, their production, functional properties and utilization in traditional and convenience foods and economic feasibility as compared to plant polysaccharides will be highlighted.

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Marvo Ideal Cream Filler

Ideal for creams, fillings and icing. Melts over a short temperature range to give an excellent non-greasy mouth feel. Takes on any imparted flavour and even aeration results in easy whipping up to provide a fluffy texture. Available in 14 kg tins.

Dawn Pan Releasing Agent

Ideal for all types of baking pans and trays as it provides a light and even coating over the whole pan for easy pan release. It is a white emulsion made from pure refined vegetable oils and does not smoke at oven temperature. It adds to the smooth surface, appearance & colour of the loaf. Available in 1 kg., 5 kg. and 10 kg Polyjars.

Marvo Aerated Shortening

Ideal for cookies and premium biscuits. It is smooth, free of lumps and evenly aerated to facilitate dispersion and prevent "fat bloom". Gives biscuits a large volume, crispness and non-greasy mouth feel. Available in 14 kg. tins.

Biskin Biscuit Fat

Ideal for all kinds of biscuits. Contains a blend of carefully selected oils which melt over a short temperature range to mix easily with dough. Gives biscuits a robust structure, increased volume and a rich taste. Available in 15 kg. tins.

FOODGRAINS STORAGE

***Venue*: Lecture Hall I**

Thursday, the 9th September, 1993

F1.04

INDUSTRIAL ENTOMOLOGY FOR FOOD AND PROTECTION OF FOODS

S.K. Majumder

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The exploitations of arthropod resources for conventional food and industrial purposes are not out of context as traditionally krill, prawn, crab, honey bee and termite have been employed as foods. Animal feeds and fish baits from both terrestrial and aquatic arthropods, the honey bee, lac insect and silkworm are also industrially used. In spite of the promise for industrial applications of insects, no attempt has been made for systematic study for their hygienic multiplication, processing technologies, evaluation of their food values, drug and therapeutic uses. They are most ubiquitous and have tremendous potential of biomass production on waste and effluents. The rapid growth and development, propensity for biosynthesis of amino acids, lipids, proteins, chitin and secondary metabolites of high value offer unique possibilities. In the present paper, the arthropods as sources of food, feed, drug, fish bait, n-triacontanol and as experimental organisms to study safety and toxicology of xenobiotics, biosynthesis of pheromones, semiochemicals and other industrial compounds and greatest substrate for production of biopesticides for food protection, mass culture as the most promising biotechnology and frontier lines of investigations are discussed.

F1.01

RECENT TRENDS IN STORED FOOD PROTECTION - AN OVERVIEW

M.K. Krishna Kumari

Infestation Control and Protectants Department,
Central Food Technological Research Institute, Mysore-570 013, India

Current approaches to pest management during storage of food emphasize the need for the integrated pest management (IPM) with a view to develop safer, more effective and sustainable use of pest control measures. Development of technologies involving biorational pesticides based on parasites, predators and semiochemicals are the major aspects of IPM. The objective of this is to reduce dependence on broad spectrum insecticides, to avoid build up of resistance, resurgence of populations and environmental contamination. Biotechnology is of immense value in manufacturing newer pesticides. Among phyto-chemicals, Indian scientists are showing keen interest in *Neem* research with biologically active chemical called limonoids, with the primary objective of developing rapidly degradative, safe and effective pesticides which can be mixed with *Bacillus thuringiensis* (bioproduct) and used.

Basic studies in insect growth and development have led to the identification of polypeptides that can be used in insect control. Genetic engineering can be utilised as a convenient source of these mechanisms through the expression of cloned genes in microbial hosts by using recombinant gene DNA technology. Two insecticides viz., M-one plus, biopesticide and MVP bioinsecticide are derived from the bacteria *Pseudomonas fluorescens*. These have been cleared by EPA, USA. Physical methods can also be used to protect stored grains. Solar energy, heat sterilization and infra red heat disinfestation also have a high potential.

Controlled atmosphere storage of grains using high concentration of CO_2 to control insects in stored products has great promise in recent years over conventional fumigants like phosphine and methyl bromide. Though practised in Australia, Malaysia, Indonesia, Thailand and Philippines, for the first time, CFTRI, Mysore has conducted laboratory and field fumigation trials with CO_2 on grain and coffee seeds. Controlled atmosphere is good for grains. The quality of the product after long term storage is superior to that of grain subjected to repeated ad hoc fumigations.

Control of insects in the future by chemicals would reach a stage of Hi-tech and sophistication; selecting easily degradable agents resulting in safety to non-target organisms and environment.

F1.03

PERSPECTIVES ON CONTROLLED ATMOSPHERE STORAGE OF FOOD GRAINS

K.S. Narasimhan and S. Rajendran

Infestation Control and Protectants Department,
Central Food Technological Research Institute, Mysore-570 013, India

Atmospheres rich in carbon dioxide (35%) that are lethal to stored product insects have been exploited for preservation of grains intended for long term storage i.e., more than 6 months. This control technique known as controlled atmosphere (CA) storage developed in Australia based on the earlier hermetic storage method is being adopted for rice storage in countries in South East Asia. The major advantages of CA storage are 1) it is a residue-free treatment and 2) it does not impair the grain quality. The feasibility of the technique was attempted for the first time in India in a buffer-storage-complex, Bombay with the collaboration of Food Corporation of India. Two rice stacks, 135 tonnes each, were preserved for 14 months under CA storage. FFA, and other parameters were not affected. The details of the carbon dioxide treatment are discussed. The cost of treatments by the conventional approach of fumigation followed by residual spray treatments and CA storage systems have been compared. The latter is especially suitable for storing basmati rice and for the commodities for which applications of insecticide and fumigants are not permitted. CA storage method has also been successfully tested for the storage of green coffee in India.

ANIMAL AND MARINE PRODUCTS

Venue: Lecture Hall I

Thursday, the 9th September, 1993

F3.03

IMPROVED TECHNOLOGY IN FISH PROCESSING AND ITS APPLICATION IN DEVELOPING COUNTRIES

D. James

FAO Fisheries Department, Viale delle Terme di Caracalla,
00100 Rome, Italy

In developed and developing countries, consumers are becoming politically powerful and are demanding high quality and safe fishery products. The technologies required to produce these products for export markets, and the standards applied, do not differ between developed and developing country producers. The developing countries can get the best financial returns by adopting sophisticated technologies and techniques to ensure quality. Many countries are responding well to this challenge. In order to increase supplies at reasonable prices to their domestic markets, developing countries have to consider innovative technologies for new products and also develop an understanding of the principles of food science and technology applied to safer and more nutritious traditional products.

F3.10

MICROBIOLOGICAL ECOLOGY OF MEAT AND POULTRY

F.H. Grau

CSIRO Meat Research Laboratory, Division of Food Processing and Technology,
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Spoilage and at times, food-poisoning organisms (e.g., *Salmonella*, *C. jejuni*, enterohaemorrhagic *E. coli*) occur on fresh meat. Procedures to maintain control of these organisms require a knowledge of their sources and of factors affecting growth and survival. The initial microbial load of carcasses is a reflection of the microbial load carried by the animal onto the slaughter floor and of the care taken in slaughter. Subsequent storage and distribution of meat is designed to prevent growth of mesophilic pathogens and to limit growth of psychrotrophic spoilage organisms. A high degree of assurance of the microbial safety and quality of meat can be provided by the application of Hazard Analysis Critical Control Point (HACCP) principles.

F3.06

MODERN DEVELOPMENT IN LIVESTOCK FEED TECHNOLOGY

P. Anand Menon

The Compound Livestock Feed Manufacturers' Association of India,
111 Mittal Chamber, Nariman Point, Bombay-400 021, India

Indian contribution to global livestock feed production is meagre. Feeding methods resorted to in developed countries cannot be accepted as such by our country. Technological innovations in animal

feeding science has contributed for increasing livestock production. Advances in manufacturing technology has to be absorbed by livestock feed industry in India, but the level of automation should be ideal for conditions prevailing here. The Compound Livestock Feed Manufacturers' Association proposes to set up an International Institute of Feed Technology at Bangalore.

F3.14

WHAT IS AHEAD OF MEAT BUSINESS IN INDIA?

N.P. Dani

Animal Products Technology Department,
Central Food Technological Research Institute, Mysore-570 013, India

The increased productivity achieved in poultry and swine production and opening of opportunities for export of meat products to West Asian countries stimulated the growth of meat processing industry. However, the tardy progress of meat processing industry is principally due to combination of factors like lack of investment in chilling, freezing and refrigerated distribution system, absence of technology for indigenous or traditional products and low purchasing power of consumers. Due to shift in the demographic pattern and accompanying socio-cultural changes, the liberalisatin of economic policy and incentives available for export oriented enterprises, the meat industry is emerging as a thrust area in food processing. The development of meat processing will largely depend on export trade in chilled and frozen meat products. The major changes in economy and market environment and increased technical capability in related fields would open opportunities for business in different sectors of meat industry. With the recent developments in research and engineering fields, there would be improved scope for introduction of innovative products in Indian market.

F3.19

THE NECESSITY FOR MODERN ABATTOIRS IN INDIA

D. Narasimha Rao

Department of Animal Products Technology,
Central Food Technological Research Institute, Mysore-570 013, India

The problems related to the Indian slaughterhouses and the need for modernising the existing slaughterhouses or establishing modern abattoirs in the country are highlighted in the paper.

Consumption of meat (sheep, goat and poultry) is increasing in the country. Fast foods based on meat and poultry are receiving greater attention in metropolitan cities and other urban areas. Export of buffalo meat has been showing an increasing trend. By-products of animal/poultry slaughter are also major income-generating items. Thus, there is a large potential for the development of meat and poultry industry in India. The consumers are becoming conscious of hygienic meat. The existence of different ethnic groups with diverse food habits sometimes based on religious practices, is also a challenge to the technologists.

Majority of Indian slaughterhouses lack basic facilities for hygienic slaughter of animals and handling of meat. Inadequate ante/post-mortem examination of meat, illiteracy of meat handlers, ignorance of

the value of hygiene among the butchers and reluctance of local bodies in improving the slaughterhouse are some of the more important drawbacks which lead to the production of poor quality meat, often leading to human diseases.

The establishment of modern abattoirs suitable to Indian conditions has, therefore, become an urgent necessity. Modern abattoir provides facilities for humane slaughter, clean meat production, proper recovery of by-products and waste treatment. Hence, the government and the local bodies should take steps to provide necessary facilities for the production of clean and hygienic meat.

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MILK PRODUCTS

***Venue*: Silver Jubilee Hall**

Thursday, the 9th September, 1993

F4.14

RESEARCH NEEDS IN DAIRY PRODUCTS WITH CHANGING WORLD ORDER

N.C. Ganguli

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India stands today at the threshold of recognition as a large milk producing country in the world. In this vital health - giving activity, India is second in the world. The country is unique as a producer of buffalo milk, constituting 55% of total milk production (56 million tonnes/yr).

Milk processing and product manufacture in India can be categorized as, a) conventional western milk products, and b) traditional indigenous milk products.

In this paper, an attempt is made to highlight some fresh directions for future research needs in dairy products. The major areas of research will be on safety, nutrition, therapeutic aspects, exotic milk proteins and peptides, Biotechnological products, environmental issues and tropical milk conservation through improved Greener Technological design and operational efficiencies.

The pressures to liberalise world trade, predicts profound changes in milk production systems in the tropical regions of developing countries to capitalise on the comparative advantages inherent in their rural based economics.

In an era of 'Naturally produced' food preference, research needs for evolving a "Greener Technology" will form the core of this presentation. Such approach will help in the development of "eco-friendly" milk products of tomorrow.

F4.02

FUTURE TRENDS IN DAIRY PRODUCTS DEVELOPMENT IN INDIA

R.P. Aneja

Foundation for Organisational Research and Education, New Delh-110 016, India

The Indian dairy industry will focus a lot of its attention on the manufacture of traditional dairy products for which a very large market at high margins has already been created by the traditional halwais. Dairy industry in India has so far been concentrating on the western type of dairy products like milk powders, baby food, butter, cheese, etc. Milk production in India is rising @ 6% p.a. and India is likely to emerge as the largest milk producing country of the world by the year 2000. Milk marketeers in India will have, therefore, to look for new products and opportunities for improving the quality of milk and milk products.

Long life milk in India has had some problems which now seem to have been sorted out. A part of the milk would, therefore, be marketed in aseptic single service containers particularly in areas that are not easy to access and also for urban households that do not have refrigerators. Even though making of *Dahi* at home is a household activity, marketing of *dahi* and yoghurt at reasonable prices provides a business opportunity in the country. This would work only if one was to operate on the basis of low margins and high turnover.

Milk powders in India are not of the instant type and with the improvement in the buying capacity of the Indian households, more convenient milk powders would be produced by the dairy industry. Also, marketing of skim milk and skim milk powders particularly aimed at the affluent sectors of the urban population is an opportunity worth exploring.

Cheese has finally arrived in India and the demand for various types of cheese and cheese spreads seems to be growing at a fast rate. All kinds of cheese particularly the middler type and those based on skim milk are likely to be the winners in the dairy products market. Even the butter market provides an opportunity away from standard sweet cream butter and consumers are likely to be looking for naturally flavoured butter, low fat butter spreads, etc.

F4.05

FERMENTED MILK AND LACTOSE INTOLERANCE

E. Renner

Dairy Science Section, Justus Liebig University, Giessen, Germany

It is well established that, in lactase-deficient subjects, fermented milk (particularly yoghurt) is better tolerated than milk which relates to the fact that lactic acid bacteria - by virtue of being rich in lactase - are able to hydrolyze the ingested lactose (so-called "autodigesting" system). In experiments, ingestion of 18 g of lactose in yoghurt resulted in only about one third as much hydrogen excretion as a similar amount of lactose in milk, it also resulted in fewer reports of diarrhoea or flatulence. The enhanced absorption of lactose in fermented milk is explained as a result of the intra-intestinal digestion of lactose by lactase released from the organisms of the lactic culture; bacterial lactase survives the passage through the stomach in lactase-deficient persons. Probably, there exist differences between various types of lactic acid bacteria as to their lactose-digesting ability.

F4.03

LACTIC BACTERIA IN QUALITY PRODUCT MAKING AND IN HUMAN HEALTH

H.K. Desai, J.M. Dave and J.B. Prajapati

SMC College of Dairy Science, G.A.U., Anand Campus,
Anand-388 110, India

Lactic acid bacteria are known since ages as benevolent microflora for human beings. Progressive increase in knowledge about their nutritional and therapeutic properties has made possible their wider applications in varieties of dairy foods. Latest technologies for manufacture of cheese and fermented milks like *yoghurt*, *acidophilus* milk, *dahi*, *shrikhand*, *bifidus* milk, etc., employ carefully selected strains of lactic bacteria so as to derive commercial and health benefits. It is now fairly confirmed that fermented dairy foods, especially those employing *L. acidophilus* and *Bifidobacter* species, exhibit powerful *in vivo* antimicrobial property against undesirable human intestinal microflora. They have been reported to possess hypocholesterolemic effect, antagonistic activity against selected malignant tumour cell lines and also non-specific immune responses. They may increase nutritional value of food by increasing the quantity, availability, digestibility and assimilability of various nutrients. Appropriate technologies are

available to maintain and preserve the selected strains of lactics which can be profitably used in preparation, diversification and enhancement of popularity and acceptability of various fermented foods.

F4.04

THERMOBACTERIOLOGY OF BUTTERMILK

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Studies were undertaken to formulate a buttermilk beverage and to preserve the same at room temperature conditions. Four single strains of lactic bacteria viz., *S. lactis*, *L. acidophilus*, *L. bulgaricus* and *BD-Y* along with a mixed traditional culture were used. Conditions standardised for buttermilk formulation included 1:2 dilution, salt 0.4 per cent, spices extract 1.5 ml per 100 ml, xanthan gum 0.1 per cent and high speed mixing for 3 min. The D values (in min) at 60 , 62 , 64 , 66 , 68 , and 70°C, respectively were for *S. lactis* 10.0, 9.0, 8.0, 8.0, 7.0 and 6.0; for *L. acidophilus* 10.0, 9.0, 8.0, 7.0, 6.0 and 6.0; for *L. bulgaricus* 10.0, 9.0, 8.0, 7.0, 7.0 and 6.0 and for *BD-Y* 10.0, 9.0, 8.0, 7.0, 7.0 and 6.0. The z values of the respective cultures were 9.0, 10.0, 10.0 and 9.0. The optimum conditions for HTST pasteurisation of the buttermilk beverage were: flow rate 200 ml per min. water bath temperature 80-85°C, inlet temperature 29 -34°C, outlet temperature 72 -75°C, temperature immediately after bottling 70-72°C, retention period in the water bath 1 min followed by slow cooling, and cooling period 30 min in bottle. There were nil survivor counts and lectic dehydrogenase activity. At 70° C (1 min), the survivor counts were for *S. lactis* 16.0×10^8; for *L. acidophilus* 16.3×10^8; for *L. bulgaricus* 14.3×10^8; for *BD-Y* 17.6×10^8 and for mixed culture 30×10^8. Only at 75 C (1 min), there were no survivors for the mixed culture. The residual lactic dehydrogenase activity was 0.55 mg of triphenyl formazan per 100 ml. The pasteurised bottled product had a shelf life of more than 140 days at ambient conditions of 29-34°C. A simple low cost process for bottling buttermilk in cottage scale will be described.

F4.12

NON-ENZYMIC BROWNING STUDIES OF MILK PROTEINS

S. Gopalan, S. Ramabadran and A. Srinivasan

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When milk is thermally processed, both in the presence and absence of reducing sugars, the protein fractions undergo Maillard reaction. The amino group of proteins interacts with carbonyl group of reducing sugars, resulting in a complex brown polymerised product. Browning was due to proteose peptone fractions interacting with reducing sugars to a greater extent. Its intensity increases with time. The brown products were analysed for amino acid content, percentage of protein and binding capacity with Cu^{++}, Zn^{++} and Fe^{++} ions. It was observed that there was a greater loss of protein only in the case of co-precipitate fraction and their readiness to bind Cu^{++} ions was also found to be much higher. This may be due to degradative end product of heterocyclic compounds from these brown materials. Studies

to find out the optimum condition of processing milk with reducing sugars in order to minimise browning have been carried out.

F4.06a

COMMERCIAL MASS PRODUCTION OF SOYMILKS FOR ADULTS (VEGEMIL A) AND BABIES (VEGEMIL B) - KOREAN EXPERIENCE

C.W. Chung

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Back in 1937, when I started my medical career as a pediatrician, there were many tragic cases of infants dying from milk indigestion due to milk allergy or lactose intolerance. This situation stimulated me to develop suitable milk substitute for such babies using soybeans. In 1967, development such milk substitute was successful and the process was patented, opening an era of soy beverage in Korea.

Production of the beverage started in a small scale in the same year. The first product, Vegemil B, clearly showed excellent results with the infants suffering from milk intake. In addition, Vegemil A was also developed for the use of adults. In order to meet the increasing demands of such products, commercial mass production was started in 1973. Today, Vegemils are produced up to 400 tons (2 millions of 200 ml pack) daily from 2 plants and distributed throughout the nation.

THERMAL PROCESSING, ASEPTIC PACKAGING AND COMPUTER APPLICATIONS

***Venue*: Silver Jubilee Hall**

Thursday, the 9th September, 1993

B5.03

EVALUATION OF THERMAL PROCESS SCHEDULE FOR CANNED ACID FOODS

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A satisfactory thermal process schedule requires three basic considerations: product safety and stability, product quality and economy of the process. Product safety and stability are the primary considerations during process evaluation and are determined by the summation of fractional lethal effects of the instant product temperatures encountered during heating and cooling operations, upon the index microorganism/factor. The summation may be carried out graphically or by formula methods. The other two considerations are achieved through process optimization. Thermal process calculations may be based on the temperatures at the slowest heating point in the container, or the probability of survival of the index factor. The presence of acids in acidic foods increases thermal sensitivity of microorganisms and therefore, the process calculations in such foods are generally based on the inactivation of enzymes. In this paper, the methods employed for evaluation and optimization of thermal process schedule for canned acid foods processed in retorts are discussed.

B2.02

TRENDS OF ASEPTIC PACKAGING IN JAPAN

Kentaro Ono

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Aseptic packaging in Japan has been developed in several technological sectors. Kureha's steam injection sterilizing system was developed as a new system for foods to be packed, as well as APV's Ohmic heating system and Toppan's microwave sterilizing system. High pressure food processing system is emerging in the research area. Utilization of gas phase hydrogen peroxide becomes in practice as an effective and safe sterilization system for packaging materials, not only flat sheet but also pre-formed containers. Shikoku's UP-FUJi-MA60 can be provided in two different interchangeable package sizes from three option sizes for one system. Clean room systems also are well developed to control the filling environment free from airborne microbes. Appreciating technological development in the aseptic packaging, solid foods such as cooked rice, cooked noodle and rice cake have been packaged to distribute in ambient conditions in Japanese market.

C1.01

THE ROLE OF COMPUTERS IN THE FOOD INDUSTRY

Israel Sam Saguy

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In the face of growing competition, the food industry must intensify its utilization of computer controlled manufacturing, which continues to solidify its base in science and engineering. One venue in a computerized environment is modelling and simulation. Simulation can be done at a macroscopic level, or at a microscopic level where each process can be analyzed and optimized. The information derived can be utilized to design and implement advanced control strategies which will improve plant operation, reduce cost and enhance quality.

Modelling, simulation and optimization are well developed and the number of procedures, including available software, is more than adequate to accomplish many of the envisioned food applications from the laboratory to the production floor. The rapid development of high speed sensors and biosensors for on-line monitoring and analysis of food quality attributes provides an immense opportunity for their implementation. Current efforts are focussed on integrating and interfacing food science, food engineering and computer technology.

The best use of computer technology will result not from the unbridled acquisition of leading-edge hardware (undergoing radical changes typified by plummeting prices, vanishing margins, and ultra short product cycles), but from innovative and disciplined management and from scientific and basic understanding of food processes and technology.

Advances and the prospective of these issues are examined and demonstrated. Examples that focus on several cases related to the food industry (e.g., aseptic processing, quality changes and optimization during processing and storage) are highlighted.

C1.02

COMPUTER APPLICATION IN THERMAL PROCESSING

Hosahalli Ramaswamy

Department of Food Science, McGill University, MacDonald Campus,
Ste Anne de Bellevue, Quebec, H9X 3V9, Canada

Thermal processing involves heating of foods packaged in hermetically sealed containers for long enough time period at a high enough temperature to eliminate the pathogenic microorganisms that endanger the public health and those microorganisms and enzymes that deteriorate the food during storage. The concept of in-container sterilization of foods, originally developed by Nicholas Appert, has gone through significant changes with respect to processing, packaging as well as process time calculations. High temperature-short time (HTST) and ultra-high temperature (UHT) techniques have been developed to minimize the severity of heat treatment and promote product quality. Aseptic processing and packaging further minimize the heat severity by quick heating and cooling of the food under aseptic conditions prior to packaging. Semi-rigid, microwaveable packages have been recently developed to

promote faster heat transfer and higher product quality due to their thinner profiles, adding the convenience of package microwaveability. Irrespective of the specific procedure, all these processes attempt to optimize the processing schedule to promote quality factor retention, while ensuring the required minimal heat treatment from public health safety view point. In this presentation, the utility of computer- based techniques for process calculations, process control and quality optimization will be discussed.

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FOOD ENGINEERING, EQUIPMENT AND ENERGY CONSERVATION

Venue: Lecture Hall II

Thursday, the 9th September, 1993

C3.01

ENGINEERING EQUIPMENT DEVELOPMENT IN THE EIGHTH FIVE YEAR PLAN

S.R. Bhowmik

Central Food Technological Research Institute, Mysore-570 013, India

Indian food processing industry is showing signs of very high growth rates. While the original estimate of investments on plant and machinery in this sector was about of Rs.3,000-4,000 crores, recent industrial liberalisation policy of the government has motivated high investments and the same is expected to be very much higher.

Food machinery manufacturing industry in India is still in its formative stage. As such, it is expected that a number of high tech. equipment would be imported along with technologies by the large scale investors. Yet, there is bound to be a proportional increase in the demand for indigeneous machinery, particularly for the manufacture of traditional foods in small scale sector.

Though a wide range of food process equipment are manufactured in the country, there are many gaps in this sector. Even in areas where sufficient design and manufacturing capabilities exist, the quality of the machinery is unsatisfactory in a majority of cases. Development activities will have to thus include both new machinery as well as quality improvement. CFTRI is the prime institution active in this area. Over the years, several plants and machinery have been developed and industrially utilised. In order to intensify the efforts in this direction, the Ministry of Food Processing Industries, is establishing a Food Engineering Centre at CFTRI. The centre would concentrate on process scale-up, plant and machinery development and other aspects of Food Engineering Research.

C3.14

FOOD MACHINERY DESIGN AND MANUFACTURE

Ezeki Berk

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The design of processing equipment for the food industry is still based, by and large, on experience, tradition and intuition. Totally rational approach to equipment design is feasible only in a few cases, such as piping and pumping systems, simple heat exchangers etc.

Evaporation is one of the most important unit operations of the food industry (sugar, milk, citrus juices, tomato concentrates); yet the key data for evaporator design, namely heat transfer coefficients, can only be "guesstimated". This is because two-phase heat transfer with annular disperse flow, which is the physical situation taking place in tubular evaporators, has not been sufficiently studied for food application.

The lack of tools for rational design leads to over-design. This is acceptable only as long as the value of the product can bear the extra capital and operating cost of oversized equipment. As cost and risk reduction become conditions for competitiveness, more effort will have to be invested for the development of such tools, through research. There are a number of success stories in this area. Satisfactory software packages are now available for the rational design of grain dryers. The mathematical modelling of

extrusion by polymer engineers has greatly reduced the need for guesswork in food extruder design. Considerable progress has been made in the application of process analysis theory to food and biotechnology, leading to the rational design of computerized process control systems, with on-line quality monitoring capability. On the other hand, in some very important recent developments, lack of adequate engineering is actually blocking the industrial application of proven technological knowledge. Examples: high-pressure sterilization/pasteurization, aseptic processing of foods with large particles, ohmic heating.

C3.19

WHAT IS NEEDED FOR DEVELOPING DESIGN AND FABRICATION OF EQUIPMENT NEEDED FOR PROCESSING FRUIT AND VEGETABLE PRODUCTS?

A. Devariya

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Global Markets for processed Fruit and Vegetable products call for following essential features and technologies:

1. Feature: Minimum of Heat Treatment in Process and better natural flavour/taste of product.

   Need: (a) Develop alternate technologies of membrane systems or chilling/freezing.

   (b) Minimise multiple heat process cycles of canning reprocess.

2. Feature: Standards of Hygiene in plant and consistent quality in product.

   Need: Adopt ISO 9000 standard, minimum of manual operations, as well as deploy continuous process designs , provided with standby cleaning circuits;

3. Feature: Conform to environmental standards.

   Need: Develop degradable/recyclable packaging materials and equipment designs.

4. Feature: Economics of process and competitiveness of price.

   Need: Develop energy efficient designs, high capacity plants, bulk and competitive packaging material appropriate to produce being marketed and its shelf life. Outdoor installation design associated with high capacity plants.

5. Feature: Operational infrastructure for uninterrupted process

   Need: Steam turbine generated captive power with down stream use of LP steam for process.

6. Feature: Human resource deployment.

Need: Personnel with appropriate academic background, endowed with good absorption capacity of technical training, observation, performance, work culture matched by professional status/emoluments and perks to motivate innovation and progress - supplemented with exposure to modern large scale process plants.

7. Feature: Infrastructure

Need: Central ISO 9000 QC infrastructure with ease of access coupled with viable service charges.

C3.04

NEEDS OF UNIT OPERATION EQUIPMENT FOR PROCESSING INDIGENOUS FRUIT AND VEGETABLE

P.V. Suryaprakasa Rao

Ushodaya Enterprises Ltd., (Priya Foods Division), Eenadu Compound, Somajiguda, Hyderabad-500 482, India

The present status of the fruit and vegetable processing industry in the country as also that of the manufacture of processing equipment and machinery is briefly reviewed. The factors responsible for the tardy growth of the industry and the poor state of the plant and equipment manufacture are highlighted. The striking and persisting deficiencies in critical areas of processing equipment manufacture are pointed out. The needs of the important segments of the industry in the context of the powerful thrusts sought to be given to it by the Governments at the Centre and in the States and in the light of the increasingly export-oriented trends in the industry are brought into focus. The dangers of wholesale or indiscriminate importation of plant and machinery required by the Industry, particularly by the 100 per cent EOUs, to the neglect and detriment of the indigenous machinery manufacturing industry are brought to light. The need for a planned systematic approach to the important and urgent task of providing the plant and equipment needs of the emerging modern export-oriented industry as well as of the indigenous products segment of the industry is stressed. The priorities to be kept in mind in this regard are indicated and a few suggestions offered.

C3.08

EQUIPMENT FOR CLEANING, GRADING AND PACKAGING OF FARM PRODUCE IN RURAL AREAS

Nawab Ali

Soybean Processing and Utilization Project, Central Institute of Agricultural Engineering, Nabi Bagh, Berasia Road, Bhopal-462 018, India

Good quality farm produces are desirable for marketing, processing and storage. To achieve this in rural areas, threshed biomass is cleaned, graded and packaged using tools and equipment such as broom,

winnowing/cleaning basket, jute/plastic mat, tarpaulin, sieve (*Chalni*), Supa and jute and woven plastic sacks. Earlier fanning mills used in rural areas for cleaning are now evolved into many styles and types of air-screen cleaners which aspirate, scalp and grade the threshed biomass with a reasonable degree of precision. Rural women get excellent results with cleaning basket, but the output is too low. This has necessitated the use of mechanical cleaner and grader by medium and large farmers and rural grain markets. Such machines are now becoming popular with individual farmer and rural markets for their own use as well as for renting because it enables farmers to get 10-15% higher income.

C3.22

PREPARATORY EQUIPMENT NEEDS OF LARGE SCALE FRUIT AND VEGETABLE PROCESSING INDUSTRY

A. Ramesh

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Preparatory operations in the processing of Fruits and Vegetables include washing, sorting, grading, peeling, slicing, dicing, grating and juice extraction. The type of equipment used varies from one commodity to another, operations in each case being different. This is particularly so in the case of fruits. Thus, a different set of machinery is required for each fruit or vegetable, if the product quality is to be superior. Further, fruits and vegetables are seasonal and it is essential for the industries to process diverse fruits or vegetables during different seasons in order to accomplish optimum utilization of the plant capacity and achieve high turn over. Such conflicting pre-requisites make production operations tricky. Indian F&V industry suffers from lack of right and high quality equipment for most preparatory operations. The paper reviews the status of the technologies employed, needs and availability of machinery for different operations.

C3.22a

A COMPARATIVE STUDY OF TECHNICAL APPROPRIATENESS OF EXTRUDERS AVAILABLE COMMERCIALLY AND THEIR SUITABILITY FOR INDIGENOUS EXTRUDED PRODUCTS AND SNACKS

N. Mallikharjuna Rao

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While the extrusion processing is not new, many novel foods are produced using this technology and it is increasingly being applied to enable conventional foods to be produced either with improved functional properties or with significant cost savings. Extrusion technology is found to be a very versatile technique for developing a large number of new foods/fabricated foods, a variety of breakfast cereals, expanded snacks, baby foods, confectionery products, textured plant proteins, macaroni, pet foods, diet formulas, analogues etc., apart from the possible applications in the field of bio-technology, production of caramel colours, sodium caseinates, co-extruded products etc. Though the extrusion of foods seems to be simple method of thermal processing, it is extremely complicated in the design of the extrusion geometry and its impact on the extruded products. A wide variety of extruders are commercially available in developed countries such as Germany, France, UK, Switzerland, Australia, Austria, U.S.A. etc. and ranging from

single screw, twin screw (corotating and counter roating screws), extruder, conical counter rotating twin screw extruder, extruder with short screw and long screw, farming extruders, etc., More than 150 companies around the world are manufacturing a variety of extruders. However, the extrusion process variables i.e., temperature of extrusion, rate of shear, moisture, protein and fat contents of feed, particle size of feed, pressure profile etc., impart significant effect on the finished product characteristics. The list of extruded foods is tremendously increasing day by day with new applications increasingly coming forth and replacing a number of commonly used food processing machinery and techniques. A variety of commerically available Indian convenience and conventional ready-to-eat foods and snacks can be made with extrusion processing which has a promising future.

E4.04

POTENTIALS FOR SOLAR ENERGY APPLICATION IN FRUIT PROCESSING

C. Palaniappan[1] and S. Kumar[2]

[1] Planters Energy Network, Madurai Kamaraj University, Madurai- 625 012,

[2] School of Energy, Environment and Natural Resources, Madurai Kamaraj University, Madurai-625 012, India

Controlled fruit processing requires large quantity of thermal energy mainly for drying. Scarcity in fossil fuels and its escalating cost along with environmental pollution make the application of the solar energy for fruit drying a sensible choice. The paper describes the general method of tapping solar heat for drying applications. The important components and their functions of solar air heater are explained. Roof integrated collectors, which are of low cost, are described. A case study of the design and performance of fruit drying/dehydration system using a 50 m2 solar air heater is discussed.

C3.16

APPLICATION OF HEAT PUMPS FOR ENERGY CONSERVATION IN DRYING OF FOOD AND AGRICULTURAL PRODUCTS

S. Srinivasa Murthy

Refrigeration and Air-conditioning Laboratory, Department of Mechanical Engineering, Indian Institute of Technology, Madras-600 036, India.

Conservation of thermal energy is of vital importance to agricultural, food and dairy industries. In food industry, nearly 65 per cent of heat requirement is at temperatures below 150°C. Also, considerable amounts of heat are rejected as waste. Thus, there is tremendous potential for heat recovery.

Annually, hundreds of millions of tons of water are removed from food and other agricultural products. One can imagine the enormity of the energy involved by simply multiplying this by the latent heat of water. At present, most of dehydration is done by hot air dryers wherein heat is supplied by steam, gas or even electricity.

The immense potential of heat pumps for industrial heat recovery cannot be over-emphasized. A heat pump is thermodynamically identical to a refrigerator except for the fact that our interest lies in the heat rejected.

The main advantage of using heat pumps when compared to other methods of heating is that they offer very high fuel utilization coefficients (ratio of energy output for heating to the primary energy input).

In this paper, different types of heat pumps, in particular, those used in drying are discussed. Specific applications and many case studies involving, agricultural products, fish, grain, malt, tea, fruits and vegetables, milk processing, etc., are presented.

The studies substantiate that heat pumps have tremendous application potential in food, agricultural and dairy industries. The typical temperature levels required for processing, and the simultaneous need for heating and cooling, make heat pumps ideal devices for achieving energy conservation. In the present scenario of rising energy costs and fast growing processed food industry in our country, priority must be given to the use of heat pumps. In addition to energy savings, heat pumps can also contribute to improvement in product quality and reduction of wastage during processing operations.

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FRUITS AND VEGETABLES - HANDLING, STORAGE, PACKAGING AND TRANSPORTATION

Venue: IFTTC Auditorium

Friday, the 10th September, 1993

F5.48

POST-HARVEST HANDLING OF FRUITS AND VEGETABLES IN DEVELOPING COUNTRIES

Christopher Yuen

Department of Food Science and Technology, P.O. Box 1,
Kensington, NSW, 2033, Australia

There is an enormous scope to significantly reduce post-harvest losses, and deliver a greater quantity and better quality fruits and vegetables to consumers in the developing countries. Potential also exists for the developing countries to take advantge of their low production and labour costs to exploit export trade. However, the present horticultural systems in developing countries are grossly inadequate, and lack the critical mass in administrative, marketing, and distribution infrastructures, the relevant post-harvest technologies, the marketing skills and intelligence, and most importantly, the basic political, human, economical and social environment needed to capture domestic and global opportunities. Accelerated improvement in post-harvest handling and management of fruits and vegetables in developing countries will only occur if there is a concurrent reduction in technical and non-technical post-harvest constraints.

F5.29

POST-HARVEST HANDLING OF FRESH PRODUCTS FOR MARKETING IN TAIWAN

Jui-Sen Yang

Food Industry Research and Development Institute,
Hsinchu, Taiwan

With the improvement in cultivation aspects of agriculture technique in Taiwan, fruits and vegetables with improved quality have been brought to daily life and provided processed food items. On the other hand, post-harvest losses varied in kind and magnitude with the handling system. Individual commodities differed greatly in their susceptibility to loss.

Post-harvest loss in Taiwan in the last decade is generally considered to be less than in the time ten years before. The loss occurred on the farm, during sorting, grading, packaging, transit, unloading, storage, wholesale marketing and retail marketing or at the consumer end of the chain. Post-harvest care is as much concerned with maintenance of quality as with quantity in Taiwan.

Shipping packages include bags, cartons or bamboo baskets. Some products are shipped without packing to markets in trucks. Supplemental packaging materials such as wraps, trays, cups, shims, liners and pads are used, although newspaper strips and rice straw are commonly applied.

Refrigeration is a popular method for storing fresh fruits and vegetables. Recently, irradiation became another technique for delaying post-harvest ripening, inhibiting sprouting, controlling insects, parasites and microorganisms. Irradiated spices and garlics have been accepted by consumers in Taiwan. On the other hand, controlled atmosphere and modified atmosphere are not commercially applied in Taiwan. The techniques for long-term storage appear to be not necessary in Taiwan because fruits and vegetables are produced or imported all the year round.

Partially prepared fresh fruits and vegetables became important products for consumer and institutional use. In future, research and development efforts are especially aimed at improving the handling procedures for maintaining the semi-processed products in a good quality.

F5.49

THE TRANSPORT OF VEGETABLES IN PUPUA NEW GUINEA

K.J. Scott

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The independent State of Pupua New Guinea (PNG) consists of approximately half the New Guinea Island (the remainder is now part of Indonesia) and Bougainville New Britain, New Ireland and a number of smaller islands. The mainland of PNG is Australia's nearest neighbour and the capital is Port Moresby.

The New Guinea island is very mountainous and few roads exist. The people in the highlands first had outside visitors 60 years ago. Some areas received outside attention only 40 years ago. There is a long tradition (9000 years) of growing vegetables in the highlands and the government has been interested in increasing production in the highlands and transporting the produce to Port Moresby where the climate is very dry and local people have shown little interest in vegetable production. Air travel is common in PNG even by remote tribesmen and air shipment of vegetables has been used for a number of years. However, the produce arriving at the capital is of poor quality and shelf life is very short.

The Australian Centre of International Agricultural Research (ACIAR) commissioned a research project to develop better means for transporting highland vegetables within PNG. The author examined the use of refrigerated containers to precool the produce and then transport the containers by road and sea. It was found the new system markedly improved the quality by reducing handling damage and that it was cost effective.

F5.36

RECENT DEVELOPMENTS IN POST-HARVEST TECHNOLOGY OF GRAPES IN INDIA

P.N. Pandey

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New Secretariat Building, Nagpur-440 001, India

In India, Maharashtra, Karnataka and Andhra Pradesh together account for about 81% of the average production of grapes. Since the country has already achieved the highest productivity of grapes in the world due to adoption of modern production technology, there is burgeoning need of reducing the existing colossal post-harvest losses, through adoption of modern post-harvest management practices, such as farm level grading, scientific packaging, precooling and refrigerated transportation. Since the country produces some of the best quality grape varieties and have comparative seasonal advantages over other countries, there are immense potentialities for diversifying its exports even to the developing countries. A promising beginning has already been made for extending modern post-harvest technological services to the farmers by *Maha* Grape and some of the private sector organisations in Maharashtra. Due to

selective adoption of integrated post-harvest technology, India is likely to emerge as one of the major leading exporters of grapes to the developing, as well as developed countries on sustained basis.

F5.41

IMPACT OF INTRODUCTION OF HYBRID TOMATO AND OTHER VEGETABLES ON FARM PRODUCTION AND PROCESSING INDUSTRIES

S.K. Berry

Central Food Technological Research Institute, Regional Centre,
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The productivity of cereal crops in this region has already reached its optimum. The recent past has witnessed a shift to high-value fruits and vegetable crops for higher returns per hectare and increased employment opportunities. This has received further impetus by way of liberal policies of the Government of India encouraging growth of agro-food processing industries. The sustenance of agro-food processing industry will now largely depend upon the good quality raw materials made available in sufficient quantities and in time. In this direction, strides have been made through the development and use of hybrid varieties and appropriate agro-techniques. The adoption of this improved technology coupled with contract farming system has ushered in a tomato revolution in Punjab. The production of tomato in Punjab has increased from less than 30,000 tonnes to more than 100,000 tonnes during the last three years with productivity, rising two to three times. These tomatoes are superior in quality with respect to consumer appeal, transportation and processing characteristics. Two large processing units in Punjab are processing tomato paste of export quality to the tune of about 10,000 tonnes per annum. Similar though less pronounced, trends have been observed in the production and availability of other vegetables in this part of the country. The paper will discuss the overall impact of the improved and hybrid varieties of some of the important vegetables, tomato in particular, on the economic advantage to the farmer, consumer and processor.

F5.30

SCIENCE AND TECHNOLOGY OF HANDLING, PACKAGING AND TRANSPORT OF FRESH FRUITS AND VEGETABLES

Gorge Marcondes

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In post-harvest operations, packaging performs several functions including protection against mechanical damage and physiological deterioration. Due to the influence of many variables, it is not totally clear how mechanical damage to horticultural products can be effectively prevented. Contrary to mechanical/electronic products, the damage assessment of agricultural products is complex, including the definition of damage which depends on consumers perception. When mechanical damage occurs, physiological degeneration is accelerated. Conversely, physiological degeneration alters the produce susceptibility to mechanical damage.

This paper will address the newest developments in protection against mechanical damage of horticultural products by means of packaging design, the recent techniques for laboratory simulation of distribution environments and testing, and the influence of relative humidity and temperature on the performance of the package/produce system. Several case studies with which the author has been involved will be presented to illustrate the theory.

F5.31

DEVELOPMENT ON TRANSPORT AND PACKAGING OF FRESH FRUITS AND VEGETABLES

Anchalee Kamolratanakul

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In an attempt to increase the economic growth of the country, the government of Thailand has put strong efforts in export promotion of fresh fruits and vegetables. To achieve successful trade, packaging is realized as an essential means. This paper reviews development on transport packaging for export of fresh fruits and vegetables, which was being conducted by Thai Packaging Centre, a national institution responsible for improving packaging standard level of the country. The development was proceeded orderly based on the principle that quality packaging must meet market requirements and ensure delivery of produce in good appealing condition. First, information concerning market requirements and produce characteristics was studied. Then, a prototype design was developed emphasizing two important properties: strength and standardised dimension. Packaging performance was evaluated next by testing on a laboratory scale before transport trial was followed. Graphic design was also an important step which should be focussed on product promotion as well as information for handling and transportation. Last but not the least, the specification of new package was established and the promotion was also needed to introduce the new development for wider application.

F5.26

DEVELOPMENT NEEDS OF POST-HARVEST HANDLING, STORAGE AND TRANSPORTATION OF FRESH FRUITS AND VEGETABLES

Susanta K. Roy

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India is one of the leading horticulturally rich countries of the world. India produces almost 100 million tonnes of fruits and vegetables including onion and potato. Unfortunately, owing to lack of proper handling, storage and transportation, it is estimated that 30% of the produce valued at Rs.4000 crores is wasted. Inadequate post-harvest management is also responsible for India's insignificant share in global export. Apart from preventing losses, post-harvest technology has great impact in sustaining the environment. By following the packing station concept if the inedible parts of fruits and vegetables are removed before sending to the market not only will the transportation cost be reduced, but environmental

pollution will also be controlled. In addition, removal of inedible parts will provide convenience to the consumer and these inedible parts may also be utilised for value-added products. This paper deals with the developmental needs of post-harvest handling, storage and transportation of fresh fruits and vegetables.

F5.36a

POST-HARVEST TECHNOLOGICAL STUDIES ON NAGPUR MANDARINS

D.P. Ukey, B.D. Sherkar, H.P. Singh and P.N. Pandey

Ministry of Rural Development, Directorate of Marketing and Inspection,
Branch Head Office, New Secretariat Building, Nagpur, India

Keeping in view, the commercial importance of Mandarins in Vidarbha region of Maharashtra, a series of post-harvest studies were conducted by the Directorate of Marketing and Inspection, to explore the possibilities of improving the marketability of this highly delicate fruit. The use of Benlate with Waxol coating was found to reduce the post-harvest losses to the extent of 11.9% over controlled consignment. The transport packaging studies revealed that the damages of the packaging material was lowest in respect of the telescopic corrugated cartons (11.1%). The storage losses of Mandarins treated with Bavistine was found to be minimum, when packed in reusable wooden boxes (only 0.31%) followed by the FCB cartons (1.45%). Sale of oranges after storage of 45 days realised an additional amount of Rs. 125 per thousand of oranges. Similarly, use of horizontal dividers, placed in the existing body of trucks at 90 cms. height resulted in substantial reduction during the long haul transit period.

F5.38

IS THERE SCOPE FOR LOW TEMPERATURE TRANSPORT OF HORTICULTURAL PRODUCE IN INDIA?

P. Narasimham

Department of Fruit and Vegetable Technology
Central Food Technological Research Institute, Mysore-570 013, India

Low temperature transport of horticultural produce for the internal trade in India is the 'missing link in the cold-chain' of post-harvest operations. This is probably the reason for the post-harvest loss of 30 per cent out of 80 million tonnes of annual production in India. Though low temperature transport can effectivly curtail post-harvest loss, paradoxically it is not much used. In developing countries like India, it is feared that the existing marketing system is a 'sellers' market. Hence, the socio-economic limitations of the consumer or the trader may render low temperature transport of horticultural produce uneconomical.

In this paper, the merits of different temperature control systems are reexamined for use of low temperature transport of horticultural produce under the prevailing socio-economic and climatic conditions as well as in the context of the changing market practices. Low temperature transport is a must. A step-wise implementation of the cost-effective systems may eventually pave the way for the commerical viability of the sophisticated refrigerated temperature controlled transport of horticultural produce in the country.

F5.39

HOW THE SCIENTIFIC POST- HARVEST HANDLING METHODS DEVELOPED FOR THE FRUITS AND VEGETABLES COULD BE MADE COMMERCIALLY VIABLE TO GIVE QUALITY PRODUCT TO THE CONSUMERS?

K.V.R. Ramana

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India produces annually about 28 million tonnes of fruits and 53 million tonnes of vegetables. Heavy losses, that is to say, 20-30% amounting to Rs. 3000-4000 crores occur annually due to defective or improper post-harvest management practices.

Of late, there is a growing awareness of fruit and vegetable quality among the consumers and also in export trade. This necessitates an urgent need for commercialisation of the promising handling practices to suit the internal and export markets. Such procedures could be implemented through the growers cooperatives, progressive private traders, super bazars and State marketing agencies. Package of technologies standardized by CFTRI for some fruits and vegetables has been outlined. Commercial application of these technologies will help in efficient distribution and marketing of the quality produce.

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STREET FOODS AND FOOD SAFETY

***Venue*: Assembly Hall**

Friday, the 10th September, 1993

E4.19

SAFETY ASPECTS OF STREET FOODS VENDING IN DEVELOPING COUNTRIES

B.J. Hartog

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Street vended foods are essential to the rapidly growing urban communities in developing countries. They provide subsistence and ready-to-eat meals even for the poorest. However, due to improper food handling practices, lack of sanitary facilities and environmental pollution, street foods get easily contaminated. They are suspected to be the main cause of foodborne diseases and are recognized as a serious hazard to health by FAO/WHO.

To improve the safety of street foods incorporation of the streetfood trade in urban planning and policy is essential. Intervention programmes should be developed in cooperation with target population and local government. Modules of such programmes should comprise simple food hygiene education as well as entrepreneurial skills. Hazard analysis critical control point (HACCP) studies are recommended to develop modules for specific foods. Experiences with the development and implementation of an intervention programme will be discussed.

E4.03

THE PRESENT STATUS AND CONTROL OF MICROBIAL FOOD BORNE DISEASES IN STREET FOODS OF CALCUTTA

Indira Chakravarty, C. Canet and B.R. Roy

All India Institute of Hygiene and Public Health,
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Microbial analysis indicated that the quality of the street foods examined in the present study was marginally inferior to those seen in earlier studies with foods from other sources.

A survey was conducted in four major areas of Calcutta, reflecting consumers of different socio-economic status covering more than fifty varieties of foods. In general, it was seen that the Standard Plate Count (SPC) of the samples was not very high in most of the cases. As expected, the SPC of *Lassi*, *Idli* and *Dahi Vada* which are made by fermentation is very high as compared to other varieties of food. SPC of *Dosa*, though a fermented product, was much less than that of *Lassi* or *Idli*, presumably due to heat treatment (frying) during its preparation. It is surprising that though the pH values of *Dosa* and *Lassi* are low and unfavourable for the growth of *Salmonella* or *Shigella*, these were detected in some samples. Probably, it is a post-process contamination and it is very alarming. One of the probable sources of *Salmonella* is the ice used in the preparation of *Lassi*. *E. coli* which mainly indicate fecal contamination was detected in 55% of the samples tested. Though all serotypes of *E. coli* are not pathogenic in nature, some of the varieties are enteropathogenic. It is understandable that the fermented foods and those containing curd (fermented milk) may contain excess of SPC, but a few unfermented products e.g., vegetable *curry*, *Ghugni* and *Alu Kabli* also indicated high SPC and some also contained pathogenic organisms; *Fuchaka* (*Panipuri*), for example, had the latter in a good measure. The hazards in these samples arose because of repeated handling and use of sub-standard water at different stages.

While a large number of different foods have been analysed for microbiological quality, a few foods were also analysed for microbiological hazards by HACCP procedure. Some festival sweets e.g., *Laddu*, was also tested microbiologically during the festive season as these are sold on the streets. However, these were not found to be microbiologically objectionable.

E4.06

MICROBIOLOGICAL SAFETY OF STREET FOODS

P.R. Kulkarni

Food and Fermentation Technology Division, Department of Chemical Technology, University of Bombay, Bombay-400 019, India

Street foods have been an important source of economical, ready-to-eat foods and beverages, particularly for the urban poor. The advantages associated with these foods are that they are inexpensive, quickly served, ready-to-eat, available in a variety and include traditional preparations. At the same time, the important problems associated with street foods include the potential for food poisoning outbreaks due to microbial contamination and use of unpermitted odours, additives or other food adulterants.

Though, there have been no epidemiological studies to suggest that street foods contribute to a significant number of food poisonings, the high potential for serious health problems related to the preparation and handling of street foods has been well recognised from studies conducted in different countries.

Lack of quality potable water, use of contaminated water, ice, inadequate cleaning of raw materials and utensils, storage of foods at ambient temperature for prolonged periods of time, use of poor quality metal utensils, contamination by flies, insects, rodents, filth, dust and unclean carrier personnel, have been clearly identified as contributors to the general sanitary conditions. Lack of facilities for disposal of waste water and refuse contributes to breeding of flies and mosquitoes which spread pathogens from sewage to nearby locations creating a serious health hazard.

Development of appropriate street food handling guidelines in consultation with government, vendors, consumer organisations, continuous monitoring of the same, education of vendors in proper food handling practices, along with appropriate potable water supply and disposable serving utensils/plates will help in producing "microbially safe" street foods.

QUALITY ASSURANCE - ISO 9000

Venue: Assembly Hall

Friday, the 10th September, 1993

E4.25

QUALITY SYSTEMS IN FOOD INDUSTRY - ROLE OF BUREAU OF INDIAN STANDARDS

A. Govindan

Bureau of Indian Standards, New Delhi, India

Food Processing Sector is one of the important sectors of the Indian Industry. The enlightened policy of the Government of India by giving importance to this sector, particularly by setting up of a separate Ministry of Food Processing to deal exclusively with the problems of food processing industry has given a fillip to this sector. With increasing focus being given to management of quality world-wide, International Organization for Standardization (ISO) has brought out a series of standards known as ISO 9000 series which clarify the relationship between the different quality concepts and present three models of quality assurance systems namely ISO 9001, 9002, and 9003. This series of standards establish requirements with which company's quality management systems can be installed, operated and also evaluated both in-house and independently by third parties.

Recognising the importance of ISO 9000 series of standards, the Bureau of Indian Standards has adopted these ISO standards and brought them out as IS 14000 series of standards. The implementation of quality systems standards by food industry would result in several benefits. Through total efforts for improvement and sustenance of quality, the industry would reap cost benefits by bringing down/eliminating failures at different stages. This would lead to consumer satisfaction and better image for the products. Satisfaction of the discerning customer in regard to both cost and quality is the single most important criterion for the growth and long term success of any organization and Quality Systems Standards would have a lion's share of contribution in this direction.

E4.32

NON-TARIFF TECHNICAL BARRIERS TO TRADE IN FOODS

Rao N. Maturu

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The importance of non-technical barriers in impeding international trade is recognized by the major food importing nations. It is also recognized by GATT which for more than forty years have provided legal frame work for conducting international trade. The non-tariff technical barriers may be related to food control or quarantine controls. Measures to remove the non-technical barriers would result in facilitating international trade.

E4.35

COMING OF AGE WITH QUALITY IN PROCESSED FOODS EXPORT

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ISO 9000 is a topic of urgent interest in the processed foods industry, since shortly it will no longer be possible to export to EEC countries unless certification is obtained under the ISO 9000 series. It is entirely possible that sooner or later, importers of other countries may be moved to follow the sample of EEC.

It would, therefore, be good to assume that in the export of processed foods, merely to stay on in the race, let alone improve its competitive edge, the Indian industry would have to make a total commitment to quality, in both mind and action, which is what ISO 9000 quality standards are all about. In this context, it is of value to consider the past experience of processed food exports from India, particularly as to the role of quality and the measures taken to assure minimum standards. It is also necessary to identify and critically look at other factors both within and outside the country which have influenced quality either for the better or worse. Searching examination in these areas will help to determine effective action for the future and the various roles individuals, institutions, associations of industries and governmental bodies may have to play in co-operation towards achieving, in the coming years, the many times over increase that is being hoped for, in the export of processed foods.

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HUMAN NUTRITION

***Venue*: Lecture Hall I**

Friday, the 10th September, 1993

E6.05

FOOD CONSUMPTION AND NUTRITIONAL STATUS OF RURAL INDIANS

Vinodini Reddy

National Institute of Nutrition, Hyderabad, India

A large proportion of rural Indians suffer from chronic energy deficiency. National Nutrition Monitoring Board (NNMB) surveys (1988-90) carried out in the same villages covered earlier, indicate that there has been no significant change in the consumption pattern of households over the last 15 years, despite an impressive increase in food production in the country. Poor access to food and low purchasing capacity appear to be the major constraints. National food policy should address these issues and aim at household food security. Anthropometric data show a definite trend towards improvement over the years, particularly in preschool children. Severe grades of growth failure and clinical forms of malnutrition have declined significantly. This improvement may be due to direct nutrition interventions targetted to the vulnerable groups. However, chronic undernutrition is still widespread in poor communities, contributing to stunted growth and reduced productivity. Nutritional well-being should be viewed as a key objective in human development and must form an integral part of all development policies and programmes.

E6.08

POSSIBILITIES FOR APPLICATION OF PROTEINS IN FOOD SYSTEMS AS A NUTRITIONAL SUPPLEMENT

G. Muschiolik

Research Group "Functionality and Application of Proteins" with the University of Potsdam, A.-Scheunert-Allee 114-116, D-14558 Bergholz-Rehbrucke, Germany

Different physico-chemical properties are necessary for proteins when they are used as functional components and are added in low concentrations to food systems to influence parameters like emulsifying, fat binding, gelling, aerating etc. and in high concentrations for improvement of the nutritional value. Examples are given to show the possibilities of selection of proteins with special physico-chemical properties for different technological steps or for utilizing protein interactions with other components of the system. Besides, the research on improving the techno-functionality of protein additives, the selection of suitable physico-chemical properties to be improved for such applications and the procedure of protein supplementation should also be given the same attention.

E6.11

CURRENT TRENDS IN RESEARCH ON BIFIDOBACTERIA AND THEIR IMPACT ON NUTRITION

A.V. Rao

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University of Toronto, Toronto, Ontario, Canada

Human intestinal microflora represents a complex ecosystem consisting of beneficial and harmful bacteria. They play an important role in influencing the health of the host. A predominance of bifidobacteria is now recognized as being essential for good health. Several factors including age and diet significantly influence their levels in the large intestine. Included among the beneficial properties of bifidobacteria are protection against gastrointestinal pathogens, cancer of the colon, and hepatic damage and the stimulation of immune surveillance. In recognition of the therapeutic potential of bifidobacteria, food and pharmaceutical industries have responded by introducing bifido-containing products for human consumption. However, the fastidious nature of bifidobacteria offers several scientific and technological challenges that have to be resolved in order to take advantage of the market potential these products offer.

E6.15

NUTRITONAL BENEFITS AND PRODUCTION OF COW-SOY MILK BLEND (VEGEMIL C)

C.V. Chung

Dr. Chung's Food Research Institute,
C/o # 194-24, 1st St. Hoehun-dong, Choong-gu, Seoul, Korea

In the course of development and production of the soy beverages, namely, Vegemil A and Vegemil B, during the past 30 years, a new product concept was evolved. The product is designed to use cow milk and soymilk in such a way as to maximize their nutritional benefits.

The rat experiments involved 4 large groups for evaluating cow milk, soymilk and cow-soy milk blends in addition to the mother's milk group as control. In all, there were 22 small experimental groups, consisting of 5 male and 5 female rats each, and were fed solely on the specific diets after weaning until they bred off-springs. Periodically, rats were examined for the body weight, activity, intelligence, breed time and endurance. Also measured were hematocrit, cholesterol and calcium contents in blood. Among the groups tested, the 1:2 raw cow-soymilk blend showed the highest score, and was thus chosen as the commercial product under the name of Vegemil C. The mass production of Vegemil C will start from May and will be available as a nutritional beverage for the use of commons.

E6.10

NUTRITION UNDER STRESS

P.K. Vijayaraghavan

136 Eldams Road, Teynampet, Madras-600 018, India

Nutritional requirements for stress conditions such as, extreme cold, extreme hot, hard physical work in high altitude conditions, space flight as well as in surgical trauma and wound healing are discussed. Energy requirements in extreme cold depends upon body size and weight, physical activity and type of clothing and footwear. In hot environments, energy requirements tend to increase. In high altitude conditions, there is reduced food utilization, negative N-balance, resulting in loss in body weight. Among the nutrients, carbohyrates are preferable for energy, while vegetable proteins present in Indian pulses aid in altitude acclamatization. Supplementation of glutamic acid in the diet enhances collagen formation and maturation during wound healing. Space flight causes, negative balance of N, Ca, P, Na and K, resulting in loss of body weight.

E6.13a

TRACE ELEMENTS AND HEAVY METAL CONTAMINATION IN FOOD AND THEIR IMPLICATIONS IN HUMAN HEALTH

K.S. Jagannatha Rao

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Heavy metals (Pb, Hg, Cd, Al) contamination in raw nd processed foods is of growing concern and even lower concentrations of these metals cause neurotoxic and nephrotoxic problems. The presence of these contaminants in food not only alters the essential trace element content in food, but also alters the bioavailablility of these latter to the human system. This leads to the deficiency of trace elements and causes disorders. The data related to the levels of metal contamination in Indian foods (raw and processed) indicate that Pb, Al, Cd, Hg were present in moderate concentrations. The bioavailability of these metals depends on their complexation in food. GEMS report (1988) indicates the presence of Pb (125 ug/kg) and CD (20 ug/kg) in human blood and kidney, respectively from selected Indian population. Metals like Pb, Al, Cd interfere in the absorption and functional efficiency of essential trace elements viz., Ca, Mg, Se, Cr as evidenced by bone, liver and brain disorders. The new vistas still open for research for clear understanding of health implications of metals through food will be presented.

E6.19

MINERAL AVAILABILITY OF HOME PROCESSED LEGUMES

B.M. Chauhan

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CCS Haryana Agricultural University, Hisar-125 004, India

Mineral deficiencies are widely prevalent in India. Legume grains are important sources of minerals in the diet, but owing to some pertinent factors, the bioavailability of minerals from these foods is low. Depending upon taste and culture, legume grains are processed, mainly at domestic level, in a number of ways before they are consumed. Domestic processing affects the level of the antinutrients in these grains and the variation in their level has a direct bearing on the availability of the minerals. Availability of minerals in foods can be predicted either by *in vitro* or *in vivo* methods. Sprouting, dehulling, roasting and fermentation bring about most pronounced improvement in the availability of minerals; other processing methods are less effective. A significant and negative correlationship between bioavailable minerals and the levels of phytates, saponins, polyphenols and fibre has been found to exist. Two *in vitro* methods namely, HCl-extractability and pepsin-pancreatin digest method correlated positively with absorption and retention of Ca, Fe and Zn in rats. *In vitro* method can, therefore, be reliably deployed and can replace time consuming, expensive and tedious *in vivo* methods for assessing the availability of minerals from legume grains. Availability *vis-a-vis* processing and not the total amounts of minerals in the legume grains signifies the contribution of these foods to mineral nutrition of human beings.

E6.18

UTILIZATION OF HOME SCIENCE RESEARCH FINDINGS FOR HEALTH AND PROSPERITY

Tara Gopaldas

WHO-Collaborating Centre, Department of Foods and Nutrition, Faculty of Home Science, M S University of Baroda, Baroda-390 002, India

This presentation will highlight how some simple, practical yet scientifically sound research findings by this rather neglected discipline(!) are being used nationally and internationally. i) The Government of India is using the weaning technology of Amylase-Rich Foods (ARF) for reduction of dietary bulk of young child foods. ii) The Government of Gujarat will institute a Health Package consisting of deworming, vitamin A, and iron supplementation in addition to a balanced cyclic Mid-Day-Meal. iii) Dried *Sundakal* powder has been proven to lower blood-sugar levels in diabetics. iv) Single-dish-balanced '*Handwa*' can be propagated for busy office-goers and v) Culture-friendly 'Fenugreek-Mother-Foods' have wide acceptability in Western India.

E6.20

DIETARY FIBRE IN HUMAN NUTRITION AND HEALTH - A CANADIAN PERSPECTIVE

A.V. Rao

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Dietary fibre, once thought of as being biologically inert is now recognized as playing an important physiological role in human nutrition and health. In Cadada, research into the relationship between the physico-chemical properties of plant fibres and their physiological effects in humans is being carried out at the University of Toronto. A long term clinical study was recently completed to investigate the effect of soluble and insoluble fibres on blood lipids and fecal composition in healthy human subjects and to study the hypocholesterolemic mechanisms of dietary fibre. Significant reductions in the levels of serum total and LDL cholesterol were obtained, while on the metabolic diets with soluble fibre providing the maximum reduction. Highly significant correlation between fecal bile acids and serum lipids indicated this mechanism to be an important determinant of the physiological effect of dietary fibre. Knowledge concerning the possible health implications of dietary fibre to the public is now being used to develop 'nutraceutical' products by the food industry.

E6.13

PROTEIN-RICH FLOUR IN HUMAN DIET, THEIR ACCEPTABILITY AND COMMERCIAL VIABILITY

G. Ramanatham

Central Food Technological Research Institute, Mysore-570 013, India

The concept of utilizing protein-rich flours for direct human consumption in order to improve nutritional status of large segment of population has been well recognized. Various technological innovations and approaches have been introduced for the fabrication of foods based on protein-rich flours. These foods have been developed to realise the number of objectives. The formulations can be classified as (i) Nutritious foods suitable for feeding children of different age groups: Infant foods, weaning foods and supplementary foods (II) Speciality foods fabricated by taking advantage of the functional properties of oilseed proteins; Textured protein products (meat extenders, *paneer* substitutes), coffee/tea whiteners, milk substitutes, beverages, protein hydrolysates, etc. An overview comprising of R and D approaches in this area, present status of few formulations and possible constraints for their slow growth in the market is presented in the paper.

Alternatively, the protein-rich flours could be utilized in the upgradation of traditional foods and preparation of dhal substitutes/extenders. The advantages of these newer approaches in terms of acceptability and commercial viability will also be discussed.

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Friday, the 10th September, 1993

F6.02

BIOTECHNOLOGICAL ADVANCES ON COFFEE BY-PRODUCTS UTILIZATION

S. Roussos[1], I. Gaime-Perraud[1], S. Denis[1], M. Raimbault[1], A. Aquiahuatl[2], M.R. Trejo[2] M. Gutierre[2], and G. Viniegra[2]

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Coffee pulp is one of the main by-products of coffee industry. Two tonnes of green coffee produce one tonne of coffee pulp (d.m.). Coffee pulp is essentially composed of carbohydrates, proteins, amino acids, mineral salts, tannins, polyphenols and caffeine. The last two compounds are reported to be anti-physiological factors in animal feed. Hence, coffee pulp has to follow a preliminary treatment before it is used. Moreover, this by-product occurs in nature and hardly spoils the environment.

In this conference, we shall present several studies based on the potential of coffee pulp on solid state fermentation (SSF), carried out by the Mexican University UAM-Iztapalapa and my group of ORSTOM in Montpellier, France. Consequently, an evaluation is made on the advances in technology on SSF process and the suitable utilization of coffee pulp as raw material to produce enzymes, biomass, fungal probiotics, biopesticides, phytohormones and other valuable products.

F6.45

HEALTH ASPECTS OF TEA POLYPHENOLS

Yukihiko Hara

Mitsui Norin Co. Ltd., Shizuoka, Japan.

The major component of tea i.e., tea polyphenols, were fractionated and their prophylactic functions both *in vitro* and *in vivo* were studied. Among tea polyphenols, catechins show very potent antioxidative activity in the lipid peroxidation system. This activity might work to prevent the oxidative deterioration of living cells or organs. Tea polyphenols interact with and inactivate certain enzymes. These characteristics will work to prevent plaque formation, suppress certain digestive enzymes and suppress hypertension. Tea polyphenols have bactericidal property at a far lower concentration than that of a daily cup of tea. Tea polyphenols suppress the growth of foodborne pathogenic bacteria, modulate favourably the intestinal flora and regulate the bowel movement.

F6.24

SPICES EXPORTS: PRESENT STATUS AND FUTURE OUTLOOK

C.K. George and B. Sreekumar

Spices Board, Govt. of India, Cochin-682 018, India

India is the largest producer as well s consumer of spices in the world. About 95% of India's production is consumed domestically. In the world spice trade, India's share is estimated to be around 30% in quantity and 9% in value. Pepper, cardamom, chilli, ginger, turmeric, garlic and seed spices like coriander, cumin, fennel, fenugreek and celery are the major spices exported from India. The value-added spice items like spice oils and oleoresins and curry powder and paste are also exported in substantial quantity. During the last five years, the export of most of the spices has shown an increasing trend. In 1992-93, an estimated quantity of 123265 tonnes of spices valued at Rs. 382.06 crores has been exported. With very high domestic demand, India faces stiff competition in the international market. The future of spice exports depends on the factors like availability, acceptability and affordability. In other words, to retain/expand our export markets, we must produce sufficient quantity of quality spices at competitive price. More thrust to export of value-added products, introduction of new spices, and quality improvement at farmers' and exporters' level are to be implemented.

F6.41

FUTURE OF PLANT TECHNOLOGY IN SPICE CROPS

K.V. Peter

National Research Centre for Spices, Calicut-673 012, India

For centuries until recently, India held a virtual monopoly in spices production and trade. India grows spices in over 2 million ha, producing 1.8 million tonnes and accounting for 20% of the world's production and 30% of international trade. The research strategy centres round building up gene base, engineering crops for quality, yield and health, rapid multiplication of elite genotypes, biocontrol of pests, multiple copies of clones and value addition. Biotechnology has great potential in spices. Possibility of production of flavour and volatile constituents in cultures, make nutmeg and vanilla tissue culture a profitable proposition. Refining techniques for micro-propagation of tree spices, in vitro selection for disease resistance in black pepper and ginger, production of virus-free planting materials in cardamom and conservation of spices germplasm in in vitro repositories are in the priorities. Organic farming also assumes importance.

F6.28

VALUE-ADDED PRODUCTS FROM SPICES

A.G. Mathew

Plant Lipids (P) Ltd., Kadayiruppu-682 311, Cochin, India

Based on indigenous technology, India has developed an efficient industry for production of spice oils and oleoresins. Research work has made it possible to find out the distribution of significant constituents in different major spices. The chemistry of aroma, pungent and colour constituents of spices like pepper, ginger, turmeric, celery and capsicum is now well understood. Emphasis laid on quality, has earned the respect of importers in developed countries.

FLAVOUR TECHNOLOGY

Venue: Silver Jubilee Hall

Friday, the 10th September, 1993

F6.09a

CROSS CULTURAL STUDIES OF JAPANESE TASTE PREFERENCES

John Prescott

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While there are major differences between the diets of Japan and Western countries such as Australia, little is known about Japanese taste preferences. CSIRO's Japan project was undertaken to study the taste preferences of Japanese consumers with a view to providing information that would help boost food exports to this A $ 500 billion food market. The results of the following generic studies comparing Japanese and Australian tastes will be reported:

* Preferences for a range of concentrations of sweet, sour, salty, bitter, and *umami* tastes;
* Sensitivity to small changes in the concentration of sweet, sour, salty and bitter tastes;
* Sensory responses to a range of sweet and salty foods;
* Sensory responses to manipulations of tastes within foods.

Other aspects of the Japan Project include providing sensory evaluation services for food companies willing to market their products in Japan, and a database containing information on the Japanese food market and culture.

F6.03

DIRECT APPLICATIONS OF INDIAN ESSENTIAL OILS AND THEIR ISOLATES IN FLAVOUR INDUSTRY AND RELATED FIELDS

N.P. Damodaran

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A concise summary of major, and selected minor Indian essential oils, and of their major/significant isolates, is presented. The conventional methods of oil recovery are referred to and recent new trends pointed out. The techniques of isolation of major components are exemplified. The direct uses of the oils and isolates in flavour and related areas (e.g., perfumery, pharmaceuticals) are recounted. The ramifications of semi-synthetic conversions of isolates of the globally abundant Turpentine oil into products useful in flavour and related fields are delineated. The recent success story of industrial semi-synthetic elaboration of ^{3}-carene, major isolate of Indian Turpentine oil, into products of flavour (perfumery and agrochemical) interest is recapitulated. Similar, current and potential applications of other Indian Essential Oils, are projected.

F6.33

DATA ANALYSIS IN FLAVOUR RESEARCH

Tetsuo Aishima

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In the past five years, flavour researchers have acquired two powerful tools as the supplements and/or substitutes for gas chromatography (GC) and conventional statistical chemometric methodologies. These are artificial neural networks (ANN) and gas sensory arrays, i.e., artificial nose. The three-layer ANN have been showing great versatility in pattern recognition and calibration for chromatographic, spectrometric and gas sensor data because of its intrinsic non-linear nature. Although aroma analysis using a bio-mimicking gas sensory array is still in infancy, several attempts for discriminating aromas using such devices have succeeded. Chemometric methodologies have been rapidly propagating in flavour research aided by rapid progress in 32 bit personal computers (PC) along with their software packages. Recent progress in flavour research has been reviewed mainly focussing on ANN and gas sensory arrays.

F6.19

TRENDS IN ENCAPSULATION OF FLAVOURS

B. Raghavan and M.L. Shankaranarayana

Central Food Technological Research Institute, Mysore-570 013, India

Food flavours which are composed of volatile components are liable for loss or deterioration on storage due to atmospheric oxidation. One of the most successful methods of protecting the flavours is micro-encapsulation. This essentially consists of providing a protective coating to the flavour using an edible matrix which may vary depending on the end use of the encapsulated flavour. There are several methods available for encapsulating the flavours such as spray-drying, spray-cooling, molten extrusion technique, gelatin encapsulation, coacervation, inclusion complexing, etc. Each of the above methods has its own merits and shortcomings; but of these, spray-drying stands out as the most widely used in the food industry due to easy availability of the industrial spray-driers and the product being cost effective. Further, the product has an extended shelf-life upto two years with only a marginal loss of flavour. However, for sensitive flavours like citrus oils, the molten extrusion technique is the preferred method.

This paper reviews the different methods of encapsulation and dwells on two major methods, namely, spray-drying and molten extrusion regarding various process and quality parameters that govern the production of encapsulated flavours. The work done in this laboratory to encapsulate spice oils and oleoresins and citrus oils and other flavourings employing the above two methods is presented. The potential for application of these encapsulated flavours in various food products is also discussed.

F6.21

STABLE FLAVOURS FOR FOOD INDUSTRY

B. Raghuramaiah

Food Ingredient Specialities Pvt. Ltd., Madras-600 040, India

Flavour is a combination of taste, ordour and perception. The acceptability of any food product derives mainly from their pleasant taste and aroma, which is due to the presence of extremely complex and well proportioned blend of many volatile and non-volatile compounds. These flavouring components exert profound effect at extremely low concentrations and play a key role, not only in the acceptance, but also in the enjoyment of foods and thus in the delivery of nutrition. It is important to note that without desirable flavours, many essential foods containing high quality proteins, other vital nutrients, etc. would not be eaten and we have experiences of the same in market place. If the product does not taste good at generally affordable cost, it will not sell in to-day's highly competitive food business. Food industry is exploring new product opportunities particularly with functional flavouring and innovative flavour systems to be in the competitive business and to meet the challenges ahead.

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PACKAGING MATERIALS AND COMPONENTS

Venue: Lecture Hall II

Friday, the 10th September, 1993

C2.10c

PACKAGING OF FOOD-INTERACTION BETWEEN THE FOOD AND PACKAGE AND PREDICTING SHELF-LIFE OF FOOD

I. Varsanyi

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A stochastic relationship is existing between the quality changing and the packaging of foods. The mechanism and the kinetics of food deterioration is controllable by storage and packaging techniques. According to our experiences, it may be stated that the physical, chemical and microbiological effects can influence directly and/or indirectly the quality changing of foods, but the quality of influences is partly known and it belongs to the composition of foods.

From the aspects of packaging the gas, water vapour and light barrier properties of packaging materials give the possibilities to predict the quantity of direct and indirect effects on packed foods. Dynamic mathematical models were elaborated to follow the quality changing of foods. These models are suitable to predict the shelf-life of foods, with special regard to the inhibitory effects of packaging on deterioration. The error of the applied method is approximately 10% in shelf-life prediction of fresh and processed foods.

C2.03

LATEST DEVELOPMENT IN TINPLATE INDUSTRY

P.K. Banerjee

The Tinplate Company of India Limited, Golmari, Jamshedpur-831 003, India

Tinplate is a versatile packaging material and has held a prime place in the packaging of a wide range of both food and non-food products for nearly 200 years. Tinplate industry, however, is now facing considerable challenges from alternative packaging materials and processes and restrictive environmental legislation. Rapid and major technological developments are taking place both in the methods of manufacture of tinplate and in the can making industry to make tinplate packaging cost effective. This paper reviews how the tinplate industry is responding to the present challenge with innovations, improvements and close team work between steel producers, tinplate manufacturers and can fabricators.

C2.02

SCOPE FOR ALUMINIUM CONTAINERS FOR THERMALLY PROCESSED FOOD

A.N. Srivatsa, S. Nadanasabapathy and Ruginini Sankaran

Defence Food Research Laboratory, Mysore-570 011, India

Two piece aluminium containers fabricated out of Al-Mg-Mn (3004) alloys as alternates for tin containers have been investigated. The alloys are available from indigenous sources. Cans of different sizes with appropriate lacquering have been developed. Various types of foods namely fruit products,

dairy products, animal foods, fish, curries and rice-based foods have been thermally processed and evaluated. Storage and transportation studies have been carried out. The investigations have revealed that aluminium containers which are being used already for beverages and drinks have a vast potential in India, for thermal processing of foods. Aluminium can be a viable alternate packaging for tin containers which are in short supply. The added natural advantages of aluminium alloys namely light weight, recyclability, easy open ends and colourless compounds of aluminium have further enhanced the scope of the use of aluminium containers.

C2.07

FLEXIBLE PACKAGING MATERIALS, THEIR COMPOSITES AND THEIR APPLICATION IN RELATION TO CRITICAL FUNCTIONAL CHARACTERISTICS OF INDIGENOUS FOODS

K.R. Kumar

Centre for Food Packaging
Central Food Technological Research Institute, Mysore-570 013, India

Development in flexible packaging of foods can be attributed to both materials and techniques. These have been applied to many indigenous food products having diverse packaging requirements. Flexible packaging systems have been employed for vacuum and gas packaging, shrink and cling packaging, *in situ* thermal processing after evaluating for appropriate barrier and performance properties and designing suitable package forms. The packages developed comprise flexible materials such as monofilms for predominantly moisture sensitive foods like convenience foods, bakery and confectionery items; bi-laminates for processed fruit products, spices and spice-products, ready-to-eat foods and confectionery; triple laminates offering high barrier properties for special savouries and snacks based on dairy products, cereals and legumes; co-extruded two and three layer films based on commodity and barrier webs have been used for a variety of processed food products. The quality parameters which are to be monitored for specific applications have been indicated.

C2.15

MERITS AND ILLS OF DIFFERENT PACKAGING MATERIALS FOR PROCESSED FOOD PRODUCTS

M. Mahadeviah

Centre for Food Packaging
Central Food Technological Research Institute, Mysore-570 013, India

Tin containers are still considered as ideal packaging material due to their ease of fabrication, high production rate, strong enough to withstand high processing temperature and its degradability. However, they pose corrosion problem and are not considered as economical. Other alternatives such as tin free steel, aluminium and plastics packaging materials have limitations with the type of product to be packed and their limited shelf-life. In addition to this, polymeric packaging materials are not biodegradable and hence they are not considered as eco-friendly packaging. Tin free steel and aluminium are recyclable and more economical than tinplate. Thin walled aluminium containers are ideally suited for beer and

beverages. Tin free steel is well suited for sulphur containing vegetbles, meat and fish products. Glass containers are safe from contamination and health hazard, impermeable to oxygen, transparent, reusable and recyclable. But, they pose transporation problem, fragile, heavy weight and cannot withstand high processing temperature.

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FRUIT PROCESSING

***Venue*: IFTTC Auditorium**

Saturday, the 11th September, 1993

F5.19

MODERN TECHNOLOGY AND EQUIPMENT FOR CONCENTRATION AND AROMA RECOVERY FROM FRUIT JUICES (PULPS RESP.) AND THEIR STORAGE REQUIREMENTS

Martin J. Kern

C/o W Schmidt-Bretten GmbH, Pforzheimerstrasse 46, FRG - 75018 Bretten

In the processing of fruit juice to concentrate, the soluble and insoluble dry substances remain in the juice concentrate, whereas the aromatic components, which disperse easily, can be reclaimed from the escaping vapours in the aromatic concentrate. Modern evaporators are now-a-days of a plate type, a multi-step construction, model Sigmaster, the special construction of which features pipes in parallel order, which operate according to the principle of the rising film evaporator. With the help of this construction, clear, cloudy and fibrous juices as well as purees can be evaporated to the conventionally commercial concentrates within the shortest space of time and with minimum thermal stress. These concentrates are of exceptional quality and cannot be compared with concentrated products, which have been obtained by evaporators of an earlier design. All aromatic substances can be converted to a concentrate with an integrated aroma recovery system in the concentrate plant. These aroma-concentrates are more durable than the non-concentrated initial product. However, they still have to be protected from oxidative and non-oxidative chemical reactions which are detrimental. Colour, smell, taste and consistency can be spoiled by inappropriate storage, rendering the product unsaleable. Quality oriented storage can only be achieved by the separate storage of aroma and juice concentrates at the lowest possible temperature, plus the exclusion of oxygen. Providing the processing of the fruits and storage of the concentrate is done correctly, the use of evaporation technique enables to produce worldwide high quality juices independent from the region of cultivation or harvesting period.

F5.27

TECHNOLOGY OF FRUIT JUICE AND PULP CONCENTRATES

B.S. Luh[1] and C.P. Natarajan[2]

[1] Department of Food Science and Technology
University of California, Davis, California, 95616, USA

[2] Central Food Technological Research Institute, Mysore-570 013, India

Processing technology on some important fruit juice and concentrates will be presented. They include citrus juice, apple juice, and tomato juice which are more important in quantity of consumption in the world. Changing in methods of processing in juice extraction, finishing, pasteurization, automation, new packaging technique has improved the economy and nutritive value of fruit juice and concentrates. Aseptic processing of fruit juice in brick pack containers has greatly improved the quality of juice which can be kept at room temperature without refrigeration. Technology has played a major part in the evolution of today's modern, shelf stable, high quality products. The future holds many new surprises and much new technology will continue further improvement through genetic engineering and horticultural practices. The sensory quality, storage stability and nutritive value of fruit juices of different kinds are very important subjects to be considered in the field of food science and technology.

F5.35

POST-HARVEST OF FRUITS AND VEGETABLES - PROBLEMS AND PERSPECTIVES

Adimilson B. Chitarra

DCA/ESAL, 37200-000 Lavras, Minas Gerais, Brazil

The demand on food supply is fast increasing throughout the world with the increase in population. The challenge of 2000 AD is to feed the 6000 million inhabitants with sufficient calories, proteins as well as vitamins and minerals. This can not be achieved just by increasing the production. Its success will largely depend on the adequate post-harvest technologies to reduce the losses in storage, conveyance and handling. Post-harvest losses of fruits and vegetables are limited to about 5% in the developed countries, whereas the developing countries suffer these losses in the vicinity of 50%. This occurs mainly with tropical fruits such as banana, mango, papaya, pineapple, water melon etc., the consumption of which is relatively large. The Brazilian technology of storage, handling and commercialization of such products in and out-side of Brazil and its problems and perspectives will be the addressing theme.

- SPICE OILS
- SPICE OLEORESINS
- NATURAL FOOD COLOURS
- FLORAL CONCENTRATES/ABSOLUTES
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FOOD SAFETY AND STANDARDS

Venue: Assembly Hall

Saturday, the 11th September, 1993

E5.04

WHAT ARE THE IMPEDIMENTS IN THE COMMERCIAL APPLICATION OF IRRADIATION OF FOOD FOR DAILY USE?

P.M. Nair

Food Technology and Enzyme Engineering Division,
Bhabha Atomic Research Centre, Bombay-400 085, India

In India, Government has accepted in principle irradiation processing of food-stuffs for human consumption. A National Monitoring Agency (NMA) was also constituted to oversee all aspects in the implementation of this technology under the Ministry of Health and Family Welfare. NMA has initially cleared the processing of economically important items like spices, frozen sea foods and onions by irradiation for export market. As a prerequisite for the control of food irradiation, Atomic Energy (Control of Irradiation of Food) rules 1991 were formulated and published in Gazette of India on March 2, 1991. NMA recommended this treatment for preservation of spices, potatoes and onions for domestic consumption. However, this clearance will become effective only after the publication of amendments to Prevention of Food Adulteration Rules to accommodate food irradiation under these rules. The draft amendments were published for public review in Gazette of India on July 3, 1992 and the finalised version will be notified soon. With this, we will be able to commercialize food irradiation.

Like any other new technology, food irradiation is also facing difficulty in ready acceptance. One of the reasons for this state of affairs is the absence of harmonized regulations acting as a barrier of trade between countries. Greater uniformity in clearance among governments is required in order to facilitate international trade. For example, international acceptance of irradiation for decontamination of spices and quarantine treatment of fruits could lead to substantial promotion of trade. Another reason is lack of consumer acceptance. The consumer organizations' concern on food irradiation includes issues of safety, wholesomeness, cost/benefit, information and freedom of choice. Most of the consumers are not aware of the benefits of this technology and are frequently alarmed by sensational press stories. Consumer education is, therefore, critical to success of food irradiation. Also, consumer should be allowed to buy and evaluate food themselves by conducting meaningful market trials. This paper will pose these problems and suggest ways and means to solve them.

E5.03

EFFECT OF GAMMA IRRADIATION AND THERMOPHILUS MILK EXTRACTS ON THE SURVIVAL OF SALMONELLAE IN CHICKEN MEAT

D.R. Rao and D.W. Thayer

Alabama A&M University, Normal, AL 35762, U.S.A.

The objective of this study was to assess the quantitative impact of the putative antimicrobial compound(s) produced by Streptococcus thermophilus on the survival and growth of Salmonella typhimurium in chicken meat simultaneously subjected to ionizing radiation. Methanol-Acetone (MA) extracts prepared from milk fermented by S. thermophillus showed broad antimicrobial activity against several foodborne organisms including S. typhimurium. In experiment I, various amounts of MA-extracts (0, 0.1, 0.2 and 0.3 ml) were added to 5 g samples of mechanically deboned chicken meat (MDCM)

inoculated with 6.1 log cells/g of S. typhimurium ATCC 14028. Samples were vacuum packed, incubated at 35 C and analyzed for salmonellae at 0 and 24 h. MA-extract reduced the initial loads (0 h samples) of salmonellae significantly in a dose response fashion (r2 = 0.979). However, MA-extract did not influence the multiplication of the surviving salmonellae (24 h samples. In experiment II, addition of 0.3 ml of MA-extract to MDCM inoculated with 9.38 log cells/g prior to irradiation (0, 0.1, 0.2 and 0.3 kGy, from Cesium-137) significantly shifted the intercept showing an additive effect of the two treatments, but there was no evidence of interaction between radiation and MA-extract treatments. The slopes of the two regression lines were not significantly different from each other. Results of this study confirm the previous observations that gamma irradiation of chicken meat reduces salmonellae loads, and S. thermophillus produces potent antimicrobial compound(s) when cultured in milk. However, the role of these putative antimicrobial compounds in reducing salmonellae in chicken meat needs further investigation.

E4.16

MICROBIOLOGICAL STANDARDS FOR PROCESSED FOODS AND RAPID METHODS FOR MICROBIOLOGICAL QUALITY ASSURANCE

R. Sankaran

Defence Food Research Laboratory, Mysore-570 011, India

Freshly cooked food if served immediately is generally safe since the pathogens get killed during cooking. But, processed foods which are stored and consumed after a period of storage require certain microbiological criteria to be employed to assure their quality and safety. No chemical method has so far been developed which can effectively detect microorganisms causing illness in man. Further, many organisms causing food-borne illness may grow in food without producing gas, off-flavour or odours and no simple chemical test can signal their presence in food. Therefore, it is very important that microbiological criteria be used as a measure of both safety and quality and standards be laid down. Several factors such as raw material quality, storge temperature, packaging material, the process employed, the environment in which it is processed, etc., affect the product quality. Various methods are employed to measure these. Earlier methods were all based on enumerating/detecting them by conventional means. But, of late, a large number of rapid detection methods and instrumentations are available such as ELISA, DEFT, RIA, PCR, Impedence Meter, Microcalorimeter, etc. Equally important for supply of safe food to consumer is employment of GMP, HACCP and LISA maxim.

E4.30

CHEMICALS WITH APPLICATIONS IN THE FOOD SYSTEM - THEIR BENEFITS AND HAZARDOUS EFFECTS

D. Rajagopal Rao

Department of Biochemistry and Nutrition
Central Food Technological Research Institute, Mysore-570 013, India.

Presence of chemical compounds in food products has come to cause concern in most countries of the world including India. They are being discovered, manufactured, marketed and consumed for their undoubted value in utility through the pre-harvest as well as post-harvest stages of the food system.

Their harmful effects on the health and life of human beings and animal species have also been proved through laboratory studies. The concern and search for alternatives to dependence on chemicals to sustain food production required for our survival is not any less intense in India than the rest of the world although the pattern of per capita consumption of chemicals as a part of food in our diets indicates levels far less than those in Europe and America.

Flavourants, colourants, nutritive additives, preservatives, antioxidants, emulsifiers, sweeteners, acidulants, plasticisers, stabilisers, fillers, foaming chemicals, taste enhancers, texturisers and last but not the least, pesticides account for most of the types of chemicals which find applications in production, protection, preservation and processing of food materials. Data and information on their properties conferring benefits and toxic effects as well as knowledge on their proper use are available in published literature. In view of primary importance of food crops and restricted options for their protection, namely applying pesticide chemicals, focus is placed on them in this paper which attempts to bring to bear a view point on the matter with respect to India in particular.

Manufacture and use of synthetic organic chemicals to protect food crops from microbes and insects, preserve food to save it from deteriorative changes and raise the sensory and nutritive status of food products are governed by systematic protocol and monitoring programmes. A point of no return seems to have been reached in sustaining food supplies with the help of chemicals which have both benefits to confer and toxic hazards. We have to provide R and D inputs in India to become self-reliant on the knowledge bearing on chemicals as well as their judicious use. Consumer education programmes have to be intensified starting with introducing the subject in the school curricula in India.

F6.18

METHODOLOGY FOR PESTICIDE RESIDUE DECONTAMINATION OF SOIL, WATER AND FOODS

N.G.K. Karanth

Department of Infestation Control and Protectants,
Central Food Technological Research Institute, Mysore-570 013, India

A limited number of methods are available for the decontamination of pesticides from soil, water and food. The methods for decontamination of soil include the use of adsorbents like charcoal, organic chemicals and microbial athletes. For the decontamination of drinking water, the conventional techniques used as Granular Activated Charcoal or Powdered Activated Carbon columns, chemical oxidations (using chlorine, permanganate, ozone and UV) ion-exchange resins, aeration or air stripping, reverse osmosis etc. Different wash solutions containing detergents, organic acids and salts are in vogue for decontamination of pesticides from food commodities. Treatments such as steam blanching, pressure cooking, exposure to high energy radiation have been reported. However, complete removal is not possible, but a feasible reduction of existing residues is attained. Such alterations can also be achieved by deploying specific bacterial consortia. Biosurfactants produced as extra cellular substances by growing microbial cells have been found to play a significant role in xenobiotic pollution abatement. Recently, we have established the production of biosurfactant by an HCH scavenging Pseudomonas strain which has the potential to dislodge surface-borne and tissue-bound HCH from contaminated fruits and vegetables.

E4.17

EFFECTIVENESS OF CONTROL METHODS OF AFLATOXIN IN FOODS

T. Shantha

Department of Microbiology and Bioengineering,
Central Food Technological Research Institute, Mysore-570 013, India

Since the discovery of aflatoxins and their recognition as health hazard to domestic and farm animals and humans, innumerable methods have been attempted to control them in foods and feeds. These include preventive, physical and chemical methods. Preventive methods recommend the use of resistant varieties of seeds and proper agronomical and storage practices. Physical methods include segregation of infected seeds and sound seeds, solvent extraction, filtration, photolysis irradiation, etc. Use of chemicals like acids, alkalis, oxidizing agents, liquor and gaseous ammonia, hydrogen peroxide etc. effectively bring down the level of aflatoxin in the commodities, but majority of them with a deleterious effect. Even biological methods using antagonistic microflora have been contemplated. In spite of all these methods, the problem of aflatoxin is neither eradicated nor controlled effectively to be within the permissible limit. Why is it so? The effectiveness and limitations of the different approaches will be discussed.

E4.31

FOOD STANDARDS AND REGULATIONS, PROTECTION OF THE HEALTH OF THE CONSUMER AND FACILITATION OF FOOD TRADE

Rao N. Maturu

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The important role of food standards and regulations in consumer protection and facilitation of food trade has been enumerated by considering related Codex activities as an example. Conformity with the Codex system of Codes of Practice Guidelines and Standards will go a long way towards achieving higher quality in foods sold. Main concerns are those associated with the use of pesticides, environmental contaminants and the newer emerging problem like residues of veterinary drugs in foods. Then, there are the questions of the safe use of food additives and of irradiation in food preservation.

HUMAN RESOURCES DEVELOPMENT

Venue: Lecture Hall I

Saturday, the 11th September, 1993

D1.11

FOOD SCIENCE AND TECHNOLOGY EDUCATION IN INDIA - THE FUTURE CHALLENGE

B.K. Mital

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The food industry in India is poised for large scale expansion and diversification in coming years. It has, therefore, become necessary to restructure and strengthen the present educational system for meeting future human resource requirements of the industry. Food technology is inter-disciplinary in nature and requires in-depth knowledge of basic as well as applied aspects of chemistry, microbiology and engineering. In addition, adequate exposure to human nutrition, economics and management are also required. Therefore, the personnel required by food industry for process control, quality assurance, research and development and managerial functions should have meaningful training in these disciplines. For this purpose, educational institutions, industry and government agencies should interact and formulate a model curriculum encompassing all these requirements. Human resource development for post 2000 A.D. era is a gigantic task and has to be accepted as a challenge by the policy makers of today.

D1.10

CURRICULUM DEVELOPMENT IN FOOD SCIENCE AND TECHNOLOGY - PAST AND PRESENT

Sunit Mukherjee

Jadavpur University, Calcutta-700 032, India

USA might be a good model for study of the development of food science and technology. With the enactment of Morrill Act, Hatch Act and Public Law 733 (Agriculture / marketing Act), Land Grant Colleges and State Agriculture Experiment Stations were created, which provided a coordinated system combining teaching, research and extension in Agriculture and Food Science. The Institute of Food Technologists in USA introduced in 1966 the UG curriculum in Food Science and Technology, which was called the "Minimum Standards". This provided the basis for a uniform core of courses for preparation of B.S. Food Technologist in 4 years after high school. There is still, large variation in the kinds of food science and technology courses offered in US and also in India. Though the modern knowledge in food processing has advanced enormously incorporating extrusion technology, membrane processes, aseptic packaging, microwave heating, supercritical fluid extraction, biotechnology and rapid techniques of monitoring food quality and safety, the need for an uniform basic education at the UG level, allowing extreme freedom at the PG level, is existing. AFST(I) can provide the leadership to evolve a curriculum at the national level.

D1.09

TRENDS IN FOOD SCIENCE AND TECHNOLOGY TEACHING

K.K. Sakariah

Central Food Technological Research Institute, Mysore-570 013, India

Rapid strides in agricultural production, industrialisation and urbanisation have transformed the art of food processing into a technology adoptable in industry. The dimensions of food science are physical, chemical, biological and psychic. Food technology stands on these basic sciences as well as engineering. A sound programme of food technology teaching should have a proper blend of these components. The general principles of food preservation are drawn from the basic food sciences and these are regardless of the origin of the food. The technology, however, depends on factors such as the origin of the food, the physical and chemical characteristics of the food material and the end product in view. Thus, a principle-oriented course of study with appropriate emphasis on commodities is necessary to train a versatile food technologist.

Traditional food technology is attaining newer dimensions with the advancement made in basic sciences. Food biotechnology is one of the newer dimensions which has to be added to food technology teaching in the immediate future. Biotechnology techniques such as plant tissue culture, gene transfer and genetically engineered microbes can be put to use in the food industry. The developments in other branches of science, as well as engineering are likely to make an impact on food technology teaching. Thus, developments in material sciences offer newer packaging materials with unique properties. Likewise, energy saving mechanisms evolved through advances in engineering scienes, membrane technology and reverse osmosis are some examples of developments capable of making an impact on the field of food technology.

D1.16

TECHNOLOGY TRANSFER THROUGH APPROPRIATE TRAINING

Kithsiri Dharmapriya

Intermediate Technology Development Group,
House-32, Road-13-A, Dhanamondi, R.A. Dhaka-1209, Bangladesh

Intermediate technology (IT) has considerable experience in the management of technology transfer through training. IT has developed a series of training courses for field workers, extension officers, social mobilisers and entrepreneurs. All these courses are successful because of the stress placed on the business development aspects of technical transfer. Examples of training will be compared and contrasted.

D1.17

INFORMATION - A KEY TO TECHNOLOGY TRANSFER

Vishaka Hedellage

Intermediate Technology Development Group,
House - 32, Road 13-A, Dhanamondi RA, Dhaka-1209, Bangladesh

There is lack of accessible information about profitable small scale food processing technologies. Storage of information about traditional technologies, being lost, has therefore, become necessary. Examples of how this information is being preserved and disseminated will be given through illustrations from Sri Lanka and Bangladesh. Intermediate technology is documenting the production of trtaditional foods that are commonly sold by small scale producers. Material has already been collected from India, Sri Lanka, Bangladesh, Peru, Guatemala and West and Southern Africa. This will enable extension workers and entrepreneurs to improve the quality of existing products and have sufficient information to develop foods that are new to their areas.

Intermediate technology (IT) has also collected information about small scale food processing equipment available throughout the world. This information has been organised as a database so that it can be used effectively. Through a variety of means ranging from publications to training courses, It is transferring this information to the people who can most benefit from it. This work will help in providing profile of traditional technologies and influence policy makers to recognise the range of available skills and expertise besides indicating the positive benefits resulting from these technologies.

D1.18

DEVELOPMENT TRENDS IN RESEARCH AND TRAINING IN HOME SCIENCE

B.M. Chauhan and Indu Grover

College of Home Science,
CCS Haryana Agricultural University, Hisar-125 004, India

Home science, a science of relating families to progress, revolves around the family ecosytem. This education aims at developing persons capable of maintaining a satisfying home, family and community life along with professional orientation. In the early part of this century, when this education was introduced, emphasis was on skills of cooking, clothing and home beautification. However, other phases of home living were added gradually and this paved way for imparting home science education on scientific lines. With the introduction of home science colleges, in the State Agricultural Universities, there has been a shift in emphasis from urban to rural families and from teaching alone to that of teaching, research and extension. Despite such changes, expectation of parents and community members has not altered much. Research in home science helps in identifying the needs of the family, interphase between family and larger society and interaction among family, science, technology and society. The base of home science research needs to be broadened and strengthened and efforts directed towards important problem areas of food production, food processing, poverty, population, drudgery, energy, employment etc. Such endeavours would go a long way in correcting imbalances and in generating basic information for sustainable development.

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Karnataka's share being 12% of total fruits and 8% of total vegetables grown in the country which consists of mangoes, banana, citrus, guava, pineapple, grapes, tomatoes, beans, bringal, capsicum, onion, potatoes. Karnataka is also rich in the production of various food grains oilseeds and marine wealth potential as well. Thus, karnataka offers great potential for the establishment of agro and food processing industries.

Food Processing Industries are covered under thrust sector by the Government of Karnataka. Thus offering higher level of incentives and concessions.

Karnataka/KSIIDC, therefore, welcomes setting up of food processing industries preferably in the medium and large scale in the state and all possible help would be extended towards the same.

For further details you may please approach with suitable proposals.

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PROCESSING OF OILSEEDS

***Venue*: Silver Jubilee Hall**

Saturday, the 11th September, 1993

F2.04

BIOTECHNOLOGY OF VEGETABLE OILS IN THE U.S.

R.G. Krishnamurthy

Kraft General Foods, 801 Waukegan Road,
Glenview, IL. 60025, U.S.A.

Plant breeding, a form of biotechnology, of oil crops for improvement and/or change of characteristics has been practised for thousands of years. The time required to achieve a desired goal by such a breeding process is generally very long. For example, development of canola, a low erucic acid variety of rapeseed, required almost 15 years. However, in the past few years a new form of biotechnology led by "tissue culture" techniques and with adaptation of techniques from the medical field is bringig revolutionary changes in the oil crops. Similarly, application of lipase enzyme to the field of oils and fats has opened up new and exciting opportunities to produce designed oils.

The current status of these technologies in the U.S.A. and their implications to the future of the edible oil industry will be discussed.

F2.07

PROTEIN FOOD FROM OILSEEDS

Danji Fukushima

Kikkoman Corporation, 1-25 Kanda Nishiki-cho,
Chiyoda-ku, Tokyo 101, Japan.

The present paper deals with (1) the off-flavour, (2) the functionalities of the proteins, and (3) the manufacturing through bioreactor, of oilseed protein foods. Non-fermented soybean protein products have two types of off-flavour, that is, green-beany flavour and objectionable after-taste, which are developed through lipoxygenases and -glucosidases, respectively. Soy milk or tofu with a minimum off-flavour has been made by preventing these enzymes from acting during the processing. In this connection, lipoxygenase deficient mutant soybeans have been induced for making better quality protein foods. Recently, the mechanism of gelation of soybean proteins has been elucidated at a molecular level. Upon this basis, attempts for the improvement of the functionalities of oilseed proteins have been made successfully on the gelation, emulsification, and nutritive value, using genetic engineering technology through the modification of a gene encoding oilseed storage proteins. Finally, the manufacturing of soy sauce through a bioreactor is described which is one of the typical fermented soybean protein foods.

F2.03

PALM OIL PROCESSING TECHNOLOGY FOR INDIA

C. Arumughan, A. Sundaresan and A.D. Damodaran

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Oil palm is the second largest source of vegetable oil in the world. The phenomenal growth of palm oil supply during the last two decades could be attributed to the large scale plantation developments in Malaysia and Indonesia. In the Indian context, oil palm holds great promise due to its incredible productivity (4.0 to 6.0 tonnes oil/ha/year) *vis-a-vis* traditional oilseeds cultivated in India (0.3 to 0.8 tonnes/ha/year). As part of the National Technology Mission on Oilseeds (TMO), oil palm has been recognised as an alternative source of edible oil for India in the years to come. Accordingly, about 0.57 million hectares irrigated lands have been identified in Southern India for oil palm plantation development. Currently, about 10,000 hectares are under oil palm in India. RRL(T) has been working on the post-harvest technology of oil palm to indigenise and to evolve appropriate technological models to suit domestic requirements with respect to processing and product utilization. High perishability of oil palm fruit, presence of an externally active lipase in the fruit and several post-harvest factors that favour faster deterioration of the oil make palm oil processing unique and therefore, integral to plantation development. A totally indigenously designed palm oil mill (POM) to process 1 tonne fresh fruit bunches (FFB) per hour to produce edible grade raw palm oil has been successfully tested and the technology transferred for commercial production. Raw palm oil, being the richest natural source of pro-vitamin A, is receiving wider acceptance for vitamin A supplementation programme among pre-school children. Down-stream processing to produce products and by-products to meet the domestic requirements are being carried out to complete the technology package. The details on the present status and future perspective on post-harvest technology of oil palm in India are presented in the paper.

F4.07

IMPROVEMENT IN COCONUT PROCESSING IN THE SOUTH-EAST ASIA

U. Samarajeewa

Department of Food Science and Technology,

University of Peradeniya, Peradeniya, Sri Lanka

Coconut is the main source of vegetable oil produced in the South-East Asian and Pacific regions. More than 75% of the coconut produced finds its way into domestic markets as coconut oil or fresh nuts. In Sri Lanka, 68% of the produce is consumed domestically as coconut milk. Only 15% is converted to desiccated coconut and 14.5% for oil to be exported. In the international market, coconut oil is faced with declining prices due to adverse publicity leading to trade restrictions. In the coconut producing countries, 24 to 90% of the nuts are converted to copra for oil. During mechanical expulsion, 10% of the oil is left in the copra meal. At domestic level, 35% of the oil is wasted and lost in the refuse on extraction of coconut milk. There is no efficient by-product utilization associated with these methods. Although several wet processes have been developed in different countries for separation of oil and proteins from the fresh kernels, the necessity for large scale operation for economic viability has limited the application of the technologies in most coconut producing countries. The cultural demand for home level consumption and small holder nature of coconut production cause additional problems in commercializing the wet processes, although they are more efficient. Thus, there is need to modernize the coconut processing industry to maintain sustainable development. Bottling of coconut milk or cream for the local markets using appropriate technologies together with plants to solvent-extract the oil from the refuse appears a viable alternative in developing the small holder sector. Technologies to process the by-products also should be available side by side. Future for coconut oil lies in marketing blended oils having more acceptable nutritional and health claims in view of the present setbacks caused by adverse publicity. The desiccated coconut industry needs to be improved applying modern food processing concepts.

F2.05

FLAVOUR FORTIFICATION AND CHARACTERIZATION OF RAW PEANUT OILS SUBJECTED TO ROASTING WITH PARTIALLY DEFATTED PEANUT MEAL UNDER VARIOUS ATMOSPHERIC CONDITIONS

Robin Y. Chiou, S.-L. Cheng[1], C.-Y. Tseng[1] and T.-C. Lin[2]

[1] Department of Food Industry, National Chiayi Institute of Agriculture, Taiwan
[2] Department of Food Processing, Agricultural Council, Executive Yean, Taiwan

Raw peanut oil was mixed with partially defatted peanut meal in a ratio of 10:1 (w/w) and roasted at 160°C for 30 min in a closed chamber under various atmospheric conditions. The addition of 10-20% moisture to peanut meal was essential for the formation of peanutty flavour in oil. A unique and pleasant roasted peanut flavour was achieved when roasting was carried out under atmospheres of carbon dioxide and helium. The free fatty acid content increased in the oil when the atmosphere during roasting consisted of oxygen, while slight decreases were observed in oils prepared using other atmospheric gas systems. After storage at 62°C for 35 days, free fatty acid and conjugated diene hydroperoxide contents increased in oils subjected to all treatments. However, the fatty acid composition in oils varied only within a limited range. Significant antioxidative activities were observed in peanut oils roasted with partially defatted peanut meal under carbon dioxide, helium and nitrogen.

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WASTE DISPOSAL AND ENVIRONMENTAL POLLUTION

***Venue*: Lecture Hall II**

Saturday, the 11th September, 1993

B4.05

WASTE DISPOSAL IN FERMENTATION INDUSTRY

G. Rangaswami

International Agricultural Consultant, 159, D K A Nagar,
Madras-600 087, India

Fermentation industry mainly utilizes organic substrates for producing industrial alcohol, alcoholic beverages, antibiotics and several other microbial products. The effluents produced by these industries are among the worst pollutants of the environment, carrying high organic load measured in terms of biological oxygen demand (BOD). Since the effluents do not carry any heavy metals, they could form rich media for biological activity. The effluent from molasses-based alcoholic distillery which carries a BOD of about 45,000 can be treated in air-tight tanks with anaerobic bacteria to produce biogas, which can replace almost the entire coal/fuel-oil requirement of the industry. The resultant digested effluent could be further cleansed by aerobic treatment in intensive fish culture ponds where the residual organic matter along with the dead and live micro-organisms are utilized as feed by the fish. The sludge and metabolites of fish collecting at the bottom of the culture pond, which are rich in plant nutrients, could be used for irrigating field crops with rich returns.

B4.08

POLLUTION CONTROL IN FOOD PROCESSING INDUSTRIES

S.K. Nimbhorkar

Kirloskar Consultants Limited, 121, Margosa Road,
Malleswaram, Bangalore 560 003, India

The food processing industries can be categorised into High, Moderate and Low Pollution load Industries depending on discharge of liquid effluents. Treatment systems for the liquid waste are well established and proven. It is necessary to maintain the treatment systems with equal importance as for production system.

The air pollution control for the industry mainly depends on the process adopted. The bag Filter, Cyclone Separators, Venturi Scrubbers are employed depending on the nature of pollutant. Where the gaseous separation is necessary, an absorption tower or scrubber may be adopted. The solid waste generated in Food Processing Industry can be utilised as compost - a natural fertiliser. The incineration being costly, composting is favoured. Land filling is also adopted at some places. The waste recovery, recycle and reuse are advocated. Methanisation of Distillery effluent and composting of the solid waste are currently practised methods. The by-product recovery wherever possible is emphasised.

B4.02

BIOGAS FROM FOOD WASTES

Krishna Nand

Microbiology and Bioengineering Department
Central Food Technological Research Institute, Mysore-570 013, India

In recent years, all over the world, recycling wastes and pollution control are recognised as important goals. The anaerobic digestion is preferred over other systems since it is a 'three-in-one' process which provides energy, digested slurry as feed or manure and also helps in reducing the extent of pollution and thus protecting the environment. This system has been followed for a number of years for treating sewage/sludge and also producing methane from cattle dung, mightsoil etc. The energy crisis has aroused interest to produce methane from alternate sources other than the cattle dung which has become in short supply in many parts of the world.

Food processing and agro-industrial wastes and agricultural residues are the major wastes of the country amounting to 877.2 million tonnes annually. There are about 18,533 food processing industries in India which process fruits, vegetables, grains, pulses, oilseeds, plantation products, milk, meat, poultry, eggs, fish and marine products and various other commodities derived principally from agricultural sources for the production of an array of consumer products and also generate staggering quantities of liquid and solid wastes. Nearly 40% of fruits and vegetables valued approximately Rs. 3,000-00 crores are lost every year due to post-harvest losses, poor storage and transportation. About 6.5 million tonnes of fruit and vegetable processing wastes generated annually are largely wasted. Energy production from food processing wastes could have a significant impact on the usage of energy for different purposes, both in rural and urban areas equally.

The industrial potential of fruits and vegetables and their processing wastes, sea food, meat, poultry processing wastes and distilleries, breweries, milk and dairy industries and other food processing industrial wastes for methane generation is reviewed extensively. The application of integrated energy system, utilization of digested slurry for animal feed or manure and amelioration in the extent of pollution are also highlighted.

FOOD STANDARDS

***Venue*: Lecture Hall III**

Saturday, the 11th September, 1993

E4.29

QUALITY ASSURANCE IN FOOD ANALYSIS LABORATORIES

G.V. Iyengar

International Human Nutrition Project, NIST, Gaithersburg, MD 20877, USA

Food Safety Surveillance Programs have increased the demands for reliable and detailed analytical data on both beneficial and harmful dietary constituents in foods and diets. Further, metrological advances in recent years have brought about considerable improvements in our understanding of the numerous measurement problems of inorganic and organic (and bacterial) constituents in food matrices. However, ensuring persistent reliability of the analytical results in routine applications is contingent upon (1) use of appropriate analytical methods, (2) frequent analysis of certified reference materials (CRMs), (3) proper use of CRMs, and (4) access to CRMs with concentration ranges of analytes representative of the whole working range that is of interest. On the other hand, experience has revealed that these measures alone do not guarantee the analytical quality since laboratories become complacent with their ability to analyze foods routinely; or because of their involvement only occasionally. In both cases, the work may be regarded as mundane and the need for systematic quality assurance is inadvertently ignored. These aspects will be discussed.

E4.26

HOW PFA CAN PROGRESSIVELY KEEP PACE WITH THE RAPID DEVELOPMENTS IN FOOD PRODUCT MANUFACTURE

O.P. Kapur

No.16, II Main, Paramahamsa Road, Yadavagiri, Mysore-570 020, India

The basic objective of Food legislation is to ensure a safe and wholesome food supply at a cost that consumers can afford. A modern food law should be sufficiently flexible to meet the needs arising from changes in the rapid developments of Food Industry.

The prevention of Food Adulteration Act and Rules (PFA) thereof contain several anamolies and incongruities which do little credit to the regulatory system.

With the increasing complexities of issues relating to food safety, it is imperative for Food Regulatory system to keep pace with the rapid developments in food product manufacture. The need for maintaining a system for updating the specifications for food products with changing scenario in the country and existing lacunae in the implementation system of PFA at Central, State and Local Bodies levels will be highlighted.

E4.28

DEVELOPMENT AND IMPLEMENTATION OF DATA QUALITY IN CHEMICAL MEASUREMENTS AND LABORATORY ACCREDITATION

M.N. Krishnamurthy

Analytical Quality Control Laboratory,

Central Food Techological Research Institute, Mysore-570 013, India

For a laboratory to produce consistently reliable data, it must implement an appropriate programme of quality assurance procedures. Analytical methods must be validated as fit for their purpose by means of collaborative studies. Much time and effort have been wasted over the years on the collaborative studies of methods which were basically incapable of being developed as standard procedures. Measurement of oxidative rancidity in oils and fats, turbidity test temperature values for oils and determination of animal fat in vegetable fat and some of the empirical analytical methods are examples. Recently, International Standards Organisations like AOAC, ISO and IUPAC have cooperated and finalised an agreed protocol on the design, conduct and interpretation of collaborative studies for data quality in analytical methods. The functioning of various working groups and how a standard method is developed will be presented. International Standards Organisation (ISO) has brought out guides on "Testing Laboratory Accreditation systems" as well as "General requirements for the competence of calibration and testing laboratories". Accreditation of a laboratory by the national accreditation scheme indicates that the laboratory has the technical competence and is applying good quality analytical principles.

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ABSTRACTS OF INVITED PAPERS

Continued On Page 193 as

LATE ABSTRACTS

For **POSTER SESSION ABSTRACTS** See Separate Publication

For **POSTER SESSION** Time Table See Overleaf

TIME SCHEDULE FOR POSTER PRESENTATION

Session, Date & Time	Subject Categories and Abstract Numbers										
	ANM	APT	BTM	DRS	FCN	FEG	FVP	GST	MBT	OFT	MIS
Session I, 7.9.93 1500 - 1630 Hrs	01 - 02	01 - 07	01 - 12	01 - 04	01 - 10	01 - 03	01 - 11	01 - 03	01 - 02	01 - 02	
Session II, 8.9.93 0930 - 1100 Hrs	03 - 05	08 - 13	13 - 23	05 - 07	11 - 19	04 - 05	12 - 22	04 - 05	03 - 04	03 - 04	01 - 02
Session III, 9.9.93 0900 - 1030 Hrs	06 - 08	14 - 19	24 - 35	08 - 10	20 - 28	06 - 07	23 - 33	06 - 07	05 - 06	05 - 06	03 - 04
Session IV, 9.9.93 1100 - 1230 Hrs.		20 - 27	36 - 47	11 - 14	29 - 38	08 - 11	34 - 45	08 - 11	07 - 09	07 - 08	05
Session V, 9.9.93 1500 - 1630 Hrs.		28 - 34	48 - 59	15 - 18	39 - 47	12 - 15	46 - 57	12 - 14	10 - 12	09 - 11	
Session VI, 10.9.93 0900 - 1030 Hrs.		35 - 41	60 - 71	19 - 22	48 - 57	16 - 19	58 - 68	15 - 18	13 - 15	12 - 14	
Session VII, 10.9.93 1100 - 1230 Hrs.		42 - 48	72 - 83	23 - 26	58 - 67	20 - 23	69 - 79	19 - 21	16 - 17	15 - 16	
Session VIII, 10.9.93 1500 - 1630 Hrs.		49 - 55	84 - 95	27 - 29	68 - 77	24 - 27	80 - 90	22 - 25	18 - 20	17 - 18	
Venue : Sessions I & II : Kalamandir Sessions III to VIII : Quadrangles of Assembly Hall, CFTRI.											

ANM : Analytical Methods

APT : Animal Products Technology

BTM : Biotechnology and Microbiology

DRS : Dairy Science

FCN : Food Chemistry and Nutrition

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F-1.04b

USE OF PYRETHROIDS ON FOOD MATERIALS - STATUS IN OTHER COUNTRIES AND SCOPE IN INDIA

G. Shankar and M.S. Mithyantha

Rallis Agrochemical Research Station,
21 & 22, Phase II, Peenya, Bangalore-560 058, India

Chemical control of insect pests has become an inevitable component of the integrated approaches being practised for preventing losses of stored foodgrains and processed food materials. While the products in current use are either becoming ineffective or have suspected side effects on humans/environment, our options are not too many. In this context, the synthetic pyrethroids assume greater role in preventing losses in storage. By virtue of their low mammalian toxicity and high potency against various pests, they stand apart from the rest of the pesticides. This paper discusses the status of registration of pyrethroids and their clearance for use in storage places and food handling establishments in other countries and scope in India.

F-5.03

DEVELOPMENT OF HORTICULTURE IN KARNATAKA AND MARKETING OF HORTICULTURAL PRODUCE

B.A. Channappa Gowda

Horticultural Producers Co-operative Marketing and Processing Society Limited,
Dr. M.H. Mari Gowda Road, Lalbagh, Bangalore-560 004

Karnataka enjoys a prominent position on the horticultural map of the country. In Karnataka, Horticultural crops are grown in an area of 12.34 lakh hectares. The main constraint in the development of horticulture is the lack of organised marketing facilities. The 'HOPCOMS' was established in the year 1959 to benefit both growers and consumers by eliminating the middlemen. The Society is supplying fresh fruits and vegetables to the consumers through 263 retail outlets and Institutional suppliers. It has opened 9 procurement centres, 5 Input supply centres and is maintaining 2 cold storages. The Society has got linkages with Co-operatives of other states. HOPCOMS has proposed to extend its activities to the entire state by opening its central godowns, procurement centres and retail outlets and to create infrastructural facilities for the export of horticultural produce.

F-5.15

METHODS FOR PROLONGING SHELF-LIFE AND TRANSPORTATION OF FRESH TOMATOES

O.C. Onwuzulu[1], D. Robinson[1] and S. Ranganna[2]

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Tomato (*Lycopersicon esculentum* Mill.) is a commercially important fruit which is grown and consumed worldwide mainly because of its nutritional significance. FAO (1990) estimated the total world production of tomato for the year 1989 to be 63.3 million metric tonnes, an increase of 32% over the production figure a decade ago. However, tomato fruit is highly perishable and post-harvest losses of up to 25% is not uncommon especially in developing countries. Under tropical room storage conditions (28 ± 5°C; 65 ± 20% RH), normal tomato fruit harvested at the mature-green stage ripens within 8 days and subsequently deteriorates. Factors responsible for short shelf-life of fresh tomato include mechanical damage during handling and transportation, accelerated ripening, senescence and microbial spoilage. Methods aimed at prolonging shelf-life involve optimization of handling and storage conditions to minimize mechanical damage and slow down the ripening process as well as efficient control of temperature and humidity of the storage environment. Results obtained by use of proper sanitation procedures, low-cost evaporative cool storage, moist saw-dust storage, cold-shock and ethanol-shock pre-storage treatments so as to minimize post-harvest losses, maintain acceptable quality and prolong storage life of fresh tomato are discussed.

F-2.07a

FUTURE OF NON-CONVENTIONAL EDIBLE OILS IN INDIA

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Though the present scenario of oilseeds in India with a record output of 21 million tonnes for 1992-'93 depicts a state of self-sufficiency, the country cannot afford to be complacent. Rising population, unsteady monsoons, sky-rocketing prices, defective distribution and crop failures due to varied reasons may throw up many challenges. A constant reliance and overdependence on a few major edible oils is certainly not warranted. It is necessary that India should go in for permanent alternatives in edible oils from unconventional sources whose impressive potential has remained grossly under-exploited.

Fifteen unconventional oils available in sizeable quantities in India have been selected and studied for their potential as edible oils. Physico-chemical characteristics and fatty acid composition of individual oils have been discussed. Thrust areas for necessary R & D work in the development of appropriate technologies and end applications of these oils in foods have been highlighted.

It is expected that India soon reaches a position of exportable surplus in the production edible oils from the combined strength of conventional and unconventional sources. A strategy for the development of durable technology is called for forthwith.

B-4.06

CHARACTERISATION AND TREATMENT METHODOLOGY FOR WASTES FROM FOOD PROCESSING INDUSTRIES

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Processes such as cleaning, shredding, pulping, juicing, canning, pasteurising, drying, pickling, packing and others, of various food items such as vegetables, fruits, milk, meat and fish contribute liquid and solid "wastes" which have a significant polluting potential on account of their high B.O.D., suspended solids, grease and other constituents. However, the reuse potential is also high, given the large volumes of effluents containing a range of nutrients. The technology for treatment of wastewaters using simple methods such as the stabilisation ponds and reuse of the pond effluents for fish culture and irrigation are well within the State-of-the-Art. Air pollution from can manufacture may also be considered relevant in this context. The paper describes the characteristics of selected food processing wastes, gives an overview of applicable waste treatment technology and outlines certain in-plant measures which could be aids in proper environmental management in the industry.

A-1.06a

DEVELOPMENT OF HORTICULTURAL AND VEGETABLE CROPS IN PUNJAB WITH SPECIAL REFERENCE TO IMPACT OF HYBRID VARIETIES AND THEIR SUCCESSFUL HANDLING AND PROCESSING

Khem Singh Gill

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The area and production of fruits and vegetables have increased manifold during the last decade. The genesis of surplus problem is not because of over production. It is, in fact, due to lack of proper marketing channels and post-harvest management facilities like pre-cooling, refrigerated transport, cold storage and commercialisation of processed foods. Suggestions have been made for improving production technology, post-harvest handling techniques and promotion of rural, small scale as well as large fruits and vegetables processing industry. Export of fresh as well as processed fruits and vegetables to the neighbouring countries has also been envisaged by curtailing freight charges.

A-1.13

TRANSFER OF TECHNOLOGY FROM R & D INSTITUTIONS TO INDUSTRY

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The innovation chain involves idea conceptualisation, establishing technical feasibility, upscaling of laboratory findings including possible design of specialised equipments, designing of projects with well defined output capacity, erection and productionisation, venture management and finally successful marketing. While research and development institutions shoulder the responsibility upto scale-up studies, the user industry will have to mobilise the wherewithal to bring it to successful production. Most of the failures reported in technology transfer in food industry can be attributed to one or more of the following factors: (a) faulty technology, (b) inadequate infrastructure, (c) improper management of the venture, (d) marketing failure, (e) limitations of financial resources, and (f) unhelpful policy of governments.

In order for any project to have a chance of success, it is imperative that attention is bestowed on the following components: (a) technology is complete in all respects, (b) technology development is based on

a market-felt need, (c) product cost is affordable to the widest segment of the consumer population, (d) quality and safety are fully assured, (e) direct market access is established, (f) government support is forthcoming, (g) food laws are flexible, (h) qualified personnel are deployed, (i) adequate and timely finance is arranged, (j) right type of packaging materials are made available in required quantity, (k) raw materials of appropriate quality and quantity flow uninterruptedly, (l) equipment fabrication and maintenance facilities are available, (m) waste disposal system is provided to meet pollution control laws, (n) power and water do not become a constraint, (o) location of production facilities is in an environmentally compatible place, (p) adequate precaution is taken to prevent product infestation and contamination, and (q) production constraints do not choke flow of product continuously to the market. Industrial projects end up in the sickness list when above facets are ignored during transfer and productionisation of technology. Proof of the success lies in full capacity utilisation of the venture at least from the third year onwards.

Some of the problems encountered in R & D institutions which have implications on successful transfer of technology include (a) narrow base of R & D projects taken-up, (b) tendency to take up "solo" work synonymous with mono-disciplinary research, (c) obsolete information and data base, (d) insulation from market place, (e) ineffective / absence of inputs from complimentary disciplines like packaging, engineering, microbiology, infestation, sensory evaluation and marketing, (f) lack of appreciation / competence about industrial / project costing, (g) time insentivity, (h) sluggish response to needs of industry, (i) mutual mistrust among R & D personnel, (j) undefined milestones, (k) absence of independent and unbiased technology assessment mechanism, (l) high cost of pilot plant facilities and their operation, (m) eagerness to publish R & D results for instant recognition, (n) inadequate incentives for greater productivity, (o) lack of faith on in-house competence, (p) absence of accountability - factors, and (q) lack of protection to intellectual property rights.

In spite of the constraints cited above, there have been a few success stories of technology transfer in Indian food industry during the last two decades. This was possible only because of close cooperation and understanding between the generator and the user of the technology and mutual appreciation of their respective strengths and weaknesses leading to determinations and persistence to achieve success.

F-4.01

FOOD TECHNOLOGY AS A MEANS OF SUSTAINABLE REGIONAL DEVELOPMENT

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Challenge of Food and Poverty that confronts Asia is the largest as compared to any other region in the world. With predominantly rural agricultural economies and nearly half the population living at or below the poverty line in several countries of the region, the only alternative is to accelerate the process of socio-economic development without any further damage to ecology and environment. In this effort, food technology has a key role to play as a means of stimulating agricultural production when per capita land availability is declining rapidly and its productivity is dropping due to continuation of ecologically unfriendly cultivation practices.

Protection of what is produced in the field in a sustainable manner and conservation of both durable and perishable food through the use of environmentally sound technologies has become more urgent than ever. This can improve food supplies without additional demand on natural resources, generate employment, reduce poverty, control exodus to cities and protect nature which is already punishing human society for its failures. Success will depend upon new national, regional and global cooperation

policies, viable plans and action programmes with adequate resource and competence inputs without further loss of time.

C-2.09

FOOD PACKING MACHINERY - PRESENT STATUS AND DEVELOPMENT NEEDS

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The objective of the paper is to take an overview of present status of Form Fill seal type packaging machines for packaging of food.

Every product especially food product has its own peculiar characteristics. An effort has been made to assess the presently available Indian machinery with respect to these peculiarities.

Considerations regarding future development needs in these machinery will revolve around market demand, statutory requirements, hygiene requirements etc. These have been considered under specific product groups.

A-1.11

AGRO AND FOOD PROCESSING INDUSTRY IN INDIA - THE STATUS AND PROSPECTS

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Agro and Food Processing needs arise from the socio-cultural and economic wants of a society and hence the emergence of organised activities in agro and food processing sector is a consequence of developments in economic and social spheres. The status of the industry, the organised and specialised activity to produce and market the intermediate or consumer goods for mass consumption, of Agro and Food Processing is traced through its origin as a primary processing activity dictated by essentiality and its development in secondary and tertiary sector achieved through the interplay of market forces. The prospects of Indian Food Industry is overviewed in the context of country's liberalised economic regime and the attempt at integrating with world economy. The emergence of two distinct sectors viz., the organised, large multiproduct companies with manufacturing and marketing of their recognised brands; and the small enterprises, attaining a resilience of their own to stay in the domestic market fighting the transnationals, but willing to avail the marketing expertise of the transnationals and large houses to be in export market, is the emerging scenario.

F-6.01

SENSORY METHODS FOR QUALITY ASSURANCE PROGRAMME IN FOOD INDUSTRY

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Quality assurance in food industry is an ordered set of planned and systematic actions necessary to provide adequate confidence that processes, products and services satisfy the requirements of quality. The single most important factors comprehensible equally to consumer and technologist is the sensory quality based on the visual, olfactory, gustatory and tactile, including kinaesthetic, perceptions. The appropriate tests for analysis of the sensory perceptions are documented only recently. The various stages in the production, processing and storage of any product when sensory quality control procedures are to be used are identified. Also, the related appropriate tests for reaching the stiplulated goals are listed along with type of panel and number of panelists required. Concern for sensory quality has extended beyond routine testing. Sensory analysis has become a dynamic force in highlighting the profile of a product. The future of sensory analysis looks bright with many companies laying equal if not more emphasis on sensory quality as compared to other instrumental measures.

F-3.01

PRESENT STATUS AND FUTURE PROSPECTS OF AQUACULTURE DEVELOPMENT IN INDIA

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Aquaculture as a separate branch of Aquatic Science has gained importance in the world arena of fish production. The water bodies are considered to be very valuable for fish production through aquaculture. The world aquaculture production has reached 15 million tonnes and it is expected to reach 22 million tonnes by the turn of the century. Asian countries dominate the field of aquaculture and account for 70% of the total fish production in which India and China occupy a sizable share in fresh water fish production. Indian sub-continent, by virtue of its strategic position in the Indian ocean has four million hectares of fresh water, one million hectares of marine water for brackishwater and eight million hectares of marine for aquaculture with a large varieties of cultivable species. Despite this huge bonanza, India has not really capitalised and aquaculture development is yet to gain its due share in the overall food production. Aquaculture production for export alone is assessed to the tune of Rs. 10,000 crores. Even though about one million hectare of coastal marshy land is available for aquaculture, only 70,700 ha are under farming at present with a production of 47,000 tonnes of shrimp, which is from both traditional and scientific farming. The rate of production is unbearably low. Out of 70,700 ha under operation, about 20,000 ha are producing at the rate of 1000 kg/ha by following scientific farming practices and only 200 ha area produce around 8000 - 10000 kg/ha/year in two crops. The highest production has gone upto 20,000 kg/ha/year in two crops in Tamil Nadu and Andhra Pradesh. India's export of fishery products, mainly from capture fisheries have touched US $ 615 million mark in 1992-93 and the contribution from aquaculture is hardly 20% of the total export. In a country like India, the culture fisheries should contribute at least on par with capture fisheries if not more. The prospects to build a billion dollar export

through shrimp farming is very bright. Cage culture for fin fishes such as seabass, seabream and groupers, oyster, clams and mussel farming, lobster and crab farming and seaweed farming are other grey areas in coastal aquaculture which are yet to take off in India.

F-3.03

POST HARVEST TECHNOLOGY OF PRAWN - AN INDIAN SCENARIO

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Seafood is considered to be among the safest foods of animal origin in the context of increasing health consciousness in the modern world and with the high unit value it has been acclaimed as one of the fastest moving commodity in the world market. Among seafoods, prawns accounts for 70% of Indian seafood exports in terms of value and over 40% in volume. Among the 15 species of prawns of commercial importance, *Penaeus indicus*, *P. monodon*, *P. semisulcatus*, , *P. merguensis*, *Parapenaeopsis* sp. and *Macrobrachium* sp. are of high export value and their continuous demand in the international market have resulted in the growth of prawn farming in India.

Appropriate post harvest technologies that could preclude wastage in raw materials, at various stages of preprocessing and processing due to improper handling, contamination, undesirable biochemical changes and quality loss, etc. are warranted towards safe processing of prawns towards meeting the increased demand for prawns in the global market.

In this paper, the present state of art in the handling practices, methods of preprocessing and processing, storage and shipment, implementation of ISO standards and Hazard Analysis Critical Control Point (HACCP) towards improvement of seafood quality and food safety and need for overall improvement of post harvest technology of prawns in India are discussed.

F-5.19a

TECHNOLOGY OF AROMA RECOVERY FOR FRUIT JUICES

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Flavours (aromas) are a very heterogeneous group of substances including far more than 100 individual compounds with, as a rule, very low odour thresholds. Major substance categories are differentiated such as, for example, alcohols, esters, aldehydes, terpenes and lactones. Fruits can be classified according to their aromatic substances. Fruits whose flavour is determined by one or a small number of known compounds have a so-called character of impact. Then there are fruits with more or less undefined flavours comprising a large number of compounds. Storage of natural fruit juices without further treatment, e.g. cold sterile storage or pasteurisation, leads in time to a clear negative alteration in the flavour. Studies have shown that this is also the case with the cut-back method previously used for orange juice. The surest way to maintain the original quality of flavour and juice for longer periods is to concentrate the fruit juice, applying an integrated flavour recovery method, followed by separate storage of the flavour/fruit

juice concentrate. The technology used is of the essence. One typical characteristics of flavour substances is that they are released from the product along with the water when it evaporates. To obtain the aromatic (flavour) substance from a fruit juice, the flavour must first enter a vapour phase. The evaporation volume required for complete evaporation of the various fruit flavour substances varies. This is followed by the actual aroma extraction process in a rectification coloumn, where the aroma substances are separated as volatile substances from the water, which is less volatile, then condensed and chilled. About 1% of the original juice volume is extracted in the form of a water-clear flavour concentrate containing some alcohol. Separate preparation and storage of the aroma concentrate facilitates storage for over a year if the applicable storage conditions such as low temperature, oxidation prevention and light exposure are maintained.

F-5.19

CONCENTRATION OF FRUIT JUICES WITH EVAPORATION

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Fruit juice concentrates are semi-finished goods the properties of which allow for worldwide marketing. Most fruits have been internationally standardized according to the RSK - Values (guide values and ranges of identification parameters including the revised method of analysis) providing clear requirements for product qualities. The long shelf life of fruit juice concentrates and the enormous volume reduction involved simplify handling and contribute to cost reductions for storage and transport. Rationalised, longer-term storage can also contribute to price stabilisation. 100% fruit juice is reduced to about 17% concentrate, which contains all of the valuable contents of the fruit juice with the exception of the highly volatile flavour substances (above all sugar, minerals, acids, vitamins and others more). Centrifugal, tubular and plate evaporators are available to make the concentrates. Conventional plate evporators have plates with a pattern of crossed lines similar to the patterns on heat exchanger plates. They are inexpensive, but are also especially sensitive to solids and fibres in the product. The plate evaporator SIGMASTAR is different in this respect: Its impressed pattern consists of parallel tubes resulting in clear flow channels that prevent product deposits. Fruit juice concentrate evaporators are always built in several effects. The multiple-effect design increases the potential overall capacity of a system, reduces total energy consumption and allows for particularly gentle product processing, since the evaporation temperatures are reduced from one effect to the next. The considerable increase in pecific vapour volume at falling temperatures must be taken into consideration when designing the various effects. The increasing concentration of the juice causes a concurrent increase in viscosity and a raising of the boiling point. Special problems involved in evaporating fruit juice to obtain concentrate are: deposits, increase in viscosity, thermal load (acceleration of Maillard reaction) and precipitations. Not all evaporator types are equally suitable for all fruit juices. The plate evaporator SIGMASTER is ideal for use with all fruits. Clear and clouded juices, juices containing fibres and *purees* can be evaporated to reduce them to commercial concentrations within a brief period without thermal damage. Hydroxymethylfurfural, furfural and dimethylhydroxyfuranone are among the indicators for thermal loads of all kinds. Remember that improper storage of concentrates is the cause of much greater increases in these indicator compounds than the evaporation process itself.

C-2.05

FOOD PACKAGING FILMS

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The paper deals with the requirements of food packaging and the selection of packaging films for food applications. Some of the important food packaging films are listed along with their properties and specific applications. As plastic films form one of the constituents of flexible packaging materials/systems, an idea of the annual production of various food items and the quantity of flexible films/laminates used for packaging for specific food items has been outlined. The consumption of flexible packaging materials currently and the demand for 1994-95 has been included. The recent trends and developments in food processing and in turn their impact on development of newer packaging materials has also been reviewed.

F-3.11

FOOD TECHNOLOGY FOR HEALTH AND PROSPERITY. MEAT HYGIENE. A SCIENCE UNDER NEW APPRECIATION

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The world is in progress of breaking up and drastically changes of the existing social order happens without any notice like a bolt from the blue. The meat hygiene concept is no exception from this general observation.

The predominant problems of public health nature related to production processing and retail handling of meat has turned out to be of rather complex and integrated nature. An acceptable solution cannot be anticipated, unless the specific problems are attacked at all steps of the food-chain from its very beginning, the raising of crops and animals to the final consumption of the meat products. Food should be safe to consume not only for the average citizen, but also for the exposed part of the population e.g., children, elderly persons, and persons suffering from immunosuppression.

D-1.12

MODERN PERSPECTIVES IN TRAINING AND EDUCATION IN FOOD AND FERMENTATION ENGINEERING

Subhash Chand

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Developments in biological and physical sciences during last three decades have resulted in a significant impact on bioprocessing industries. The enhanced potential of improved processing technologies involving living cells or cell constituents can only be realized in practice, if adequately trained process engineers, capable of handling challenges associated with 'new biology' are available. The broad objectives of any programme for training such manpower should be to equip the students with the capability of innovation, analysis, design and optimal operation of the process. The presentation would cover examples of products/processes related to food and fermentation technology, associated critical scientific issues and a model curriculum for an effective training programme.

F-2.05

APPLICATION OF LIPASES IN FOOD INDUSTRY

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During the past quarter of a century, there has been a steady and growing shift in consumer preference for foods that are perceived as natural, nutritious and healthful. Processed food ingredients like sweeteners, emulsifiers, flavour chemicals produced via enzymatic route are widely replacing their synthetic counterparts. Lipases known to catalyze hydrolysis of oils and fats, have shown a great potential for their use in non-polar medium (microaqueous) to carry out synthetic reactions. The specificity and regioselectivity associated with lipases can be utilized for producing a number of important food ingredients via esterification/interesterification reactions. Some of the important applications include modification of glyceride composition of naturally occurring oils/fats, synthesis of mono-glycerides, sugar esters and flavours. The process parameters critical to these applications will be reviewed.

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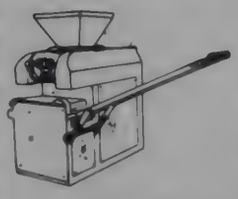

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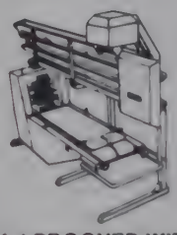

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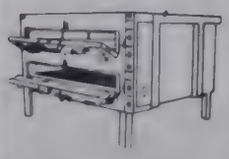

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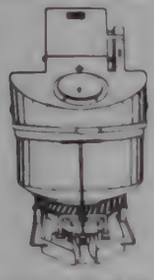

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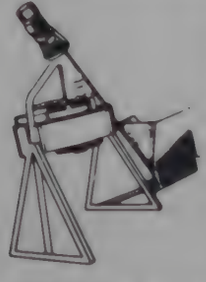

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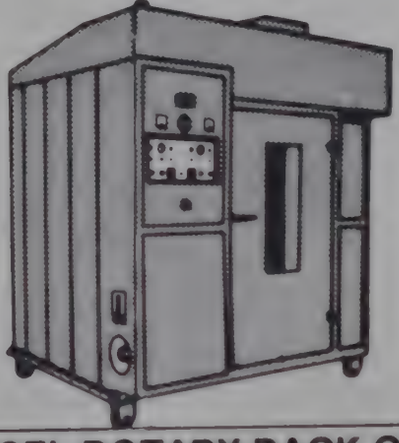

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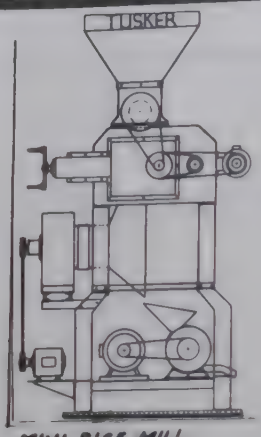

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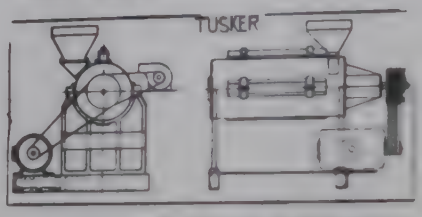

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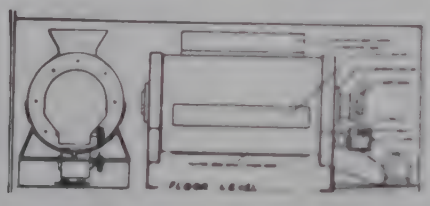
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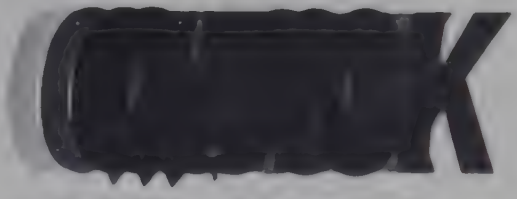

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The Maharashtra State Agricultural Marketing Board, Pune, has been established under the Maharashtra Agricultural Produce Marketing (Regulation) Act, 1963. It coordinates the functions of the Market Committees, undertakes state level planning for their development, maintains and administers Agricultural Marketing Development Fund, provides advise to Market Committees for Civil constructions and other matters, grants them loans for various purposes, organises National and State level Seminars, Workshops and also arranges publicity and propoganda on matters relating to marketing of agricultural produce. The Board has shouldered responsibility of modernising markets by installing computers, telexes, electronic weighbridges etc. In order to update knowledge of the employees of Market Committees, it conducts training programmes. The important promotional activity undertaken by the Board relates to provision of assistance for organisation of Grape Growers, Mango Growers, Banana Growers and fruits and vegetables marketing cooperatives and further organisation of 'Mahagrapes', 'Mahamango' and 'Mahabanana' for export of grapes, mangoes, bananas, pomegranates and other fruits and vegetables.

The Board has now fullfledged project consultancy cell which undertakes preparation of various types of project reports. In order to safegaurd the interest of growers, the Board is implementing a scheme of pledge of agricultural produce through selected Market Committees and for this purpose provides finance to such Committees.

The Board has a plan to set-up Post Harvest Technological Institute for educating farmers in proper production, grading, packaging, preservation, transport, etc on 140 acres of land provides by Maharashtra Government and setting-up Rajarshi Shahu Agricultural Marketing Training Complex.

The Board's initiative led to formation of Maharashtra Floriculture Development Cooperative Society for development of floricultural activities and subsequently taking up export of cutflowers. The Board is thus a friend, philosopher and guide of the Growers and their Market Committees.

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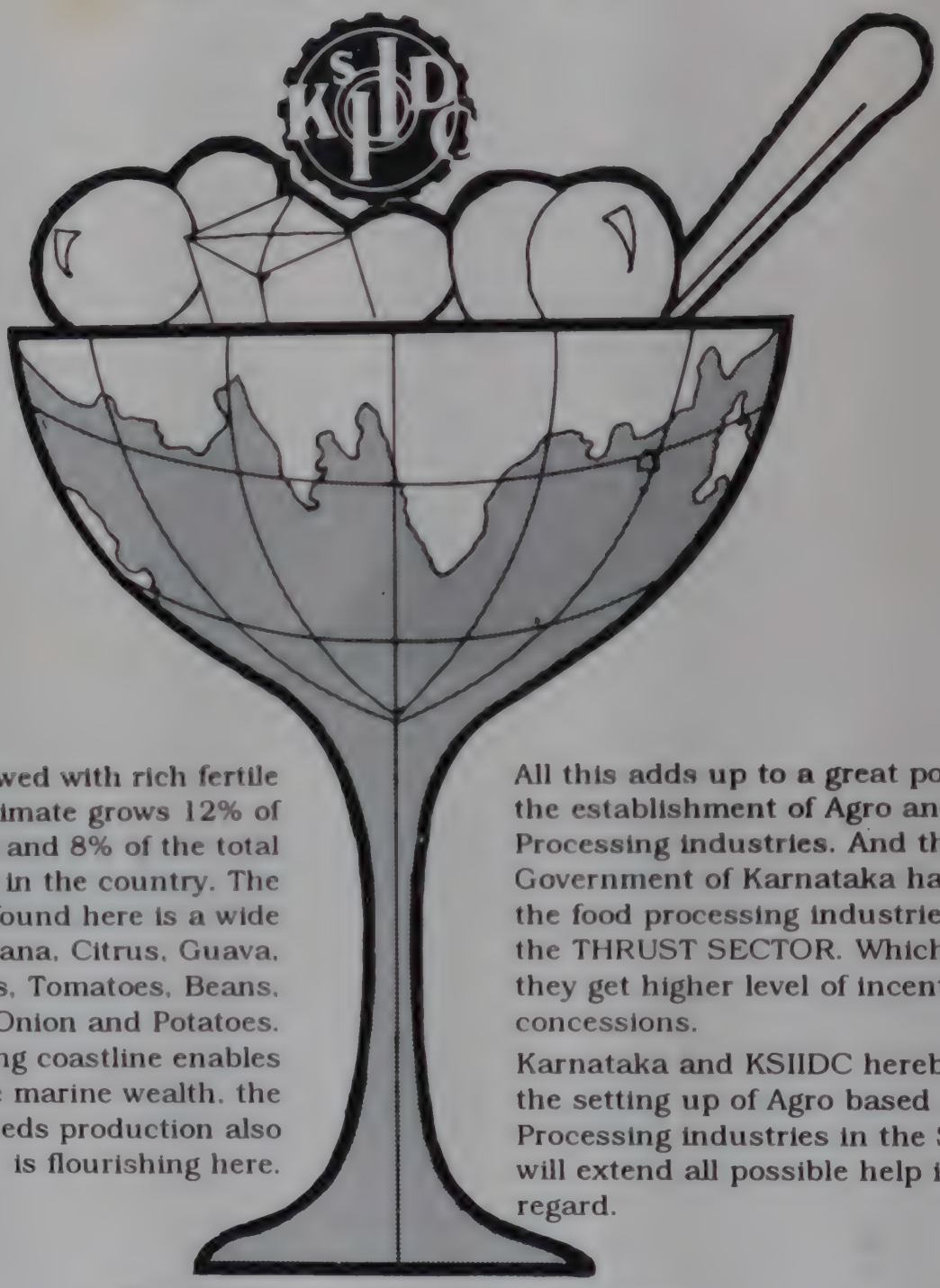

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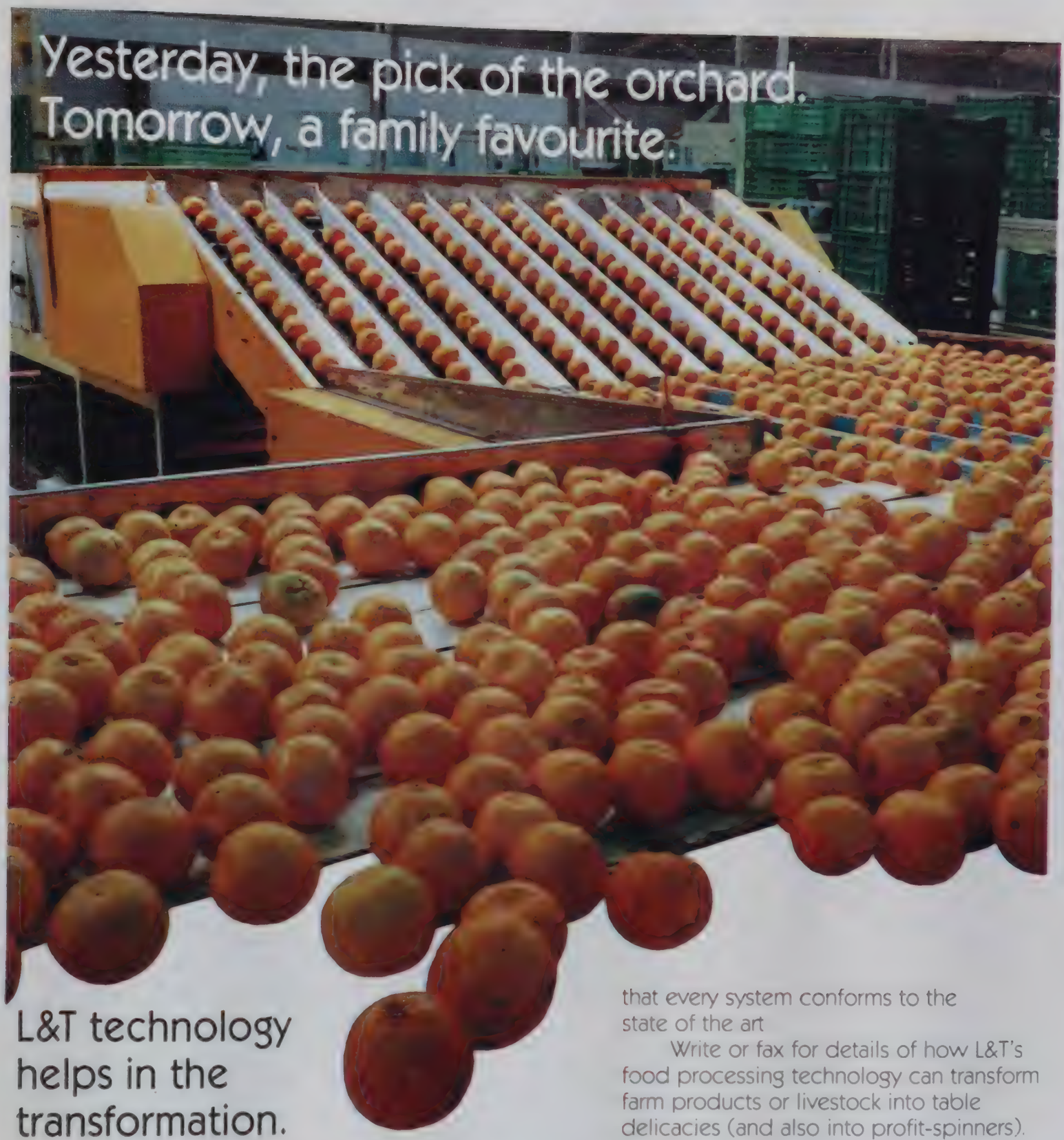

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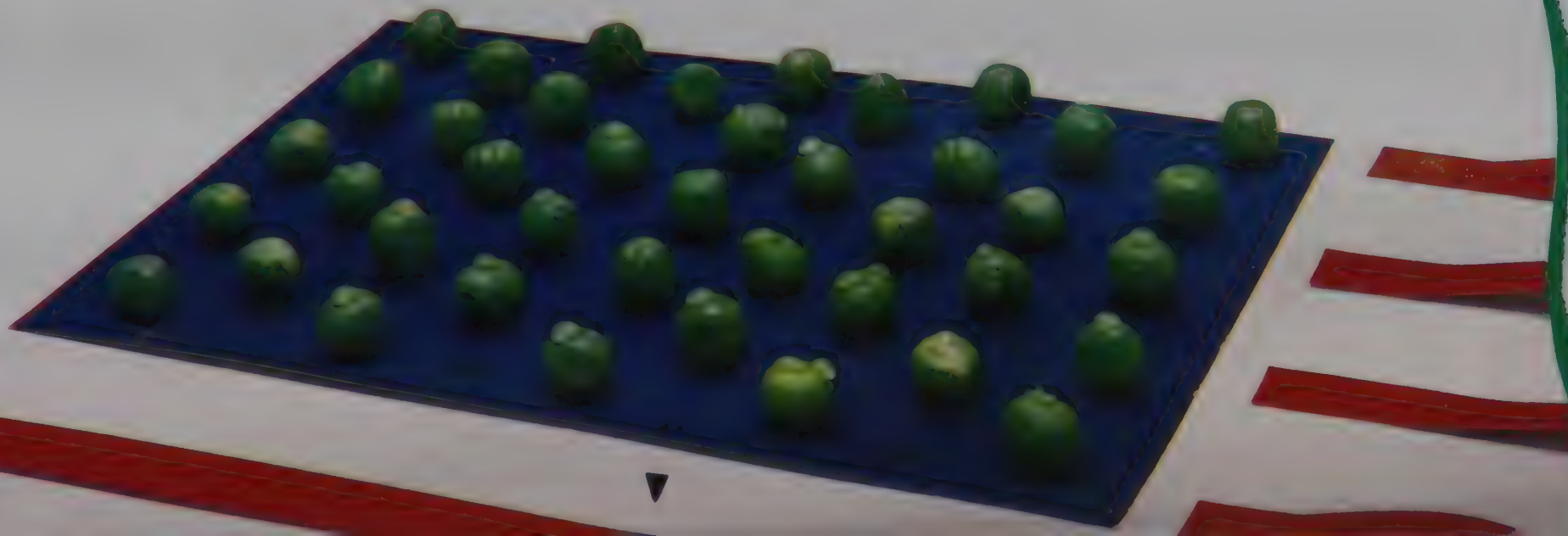

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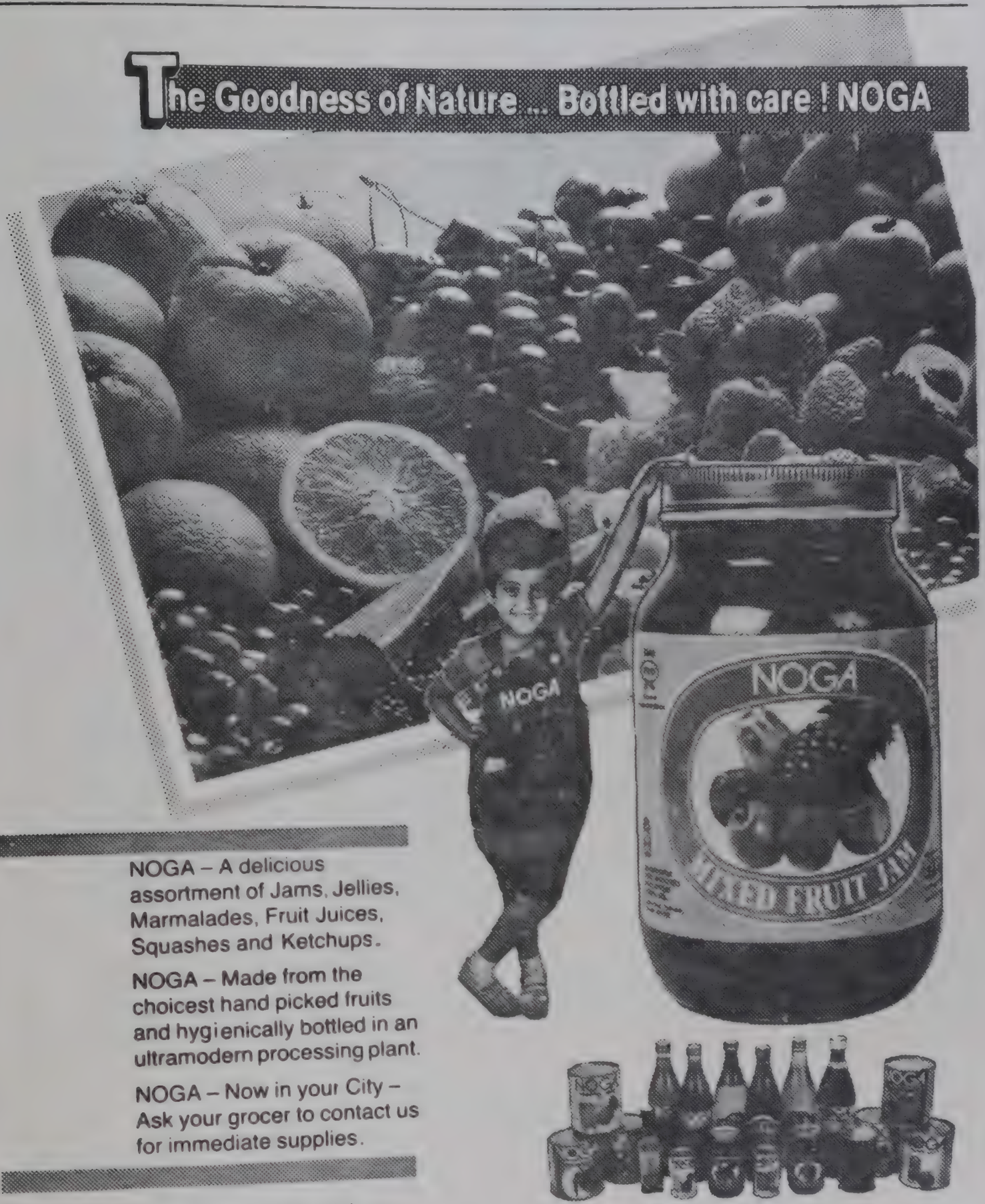

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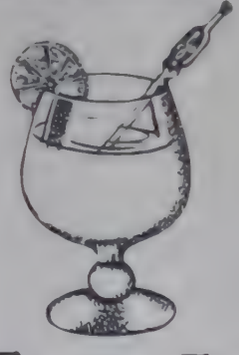

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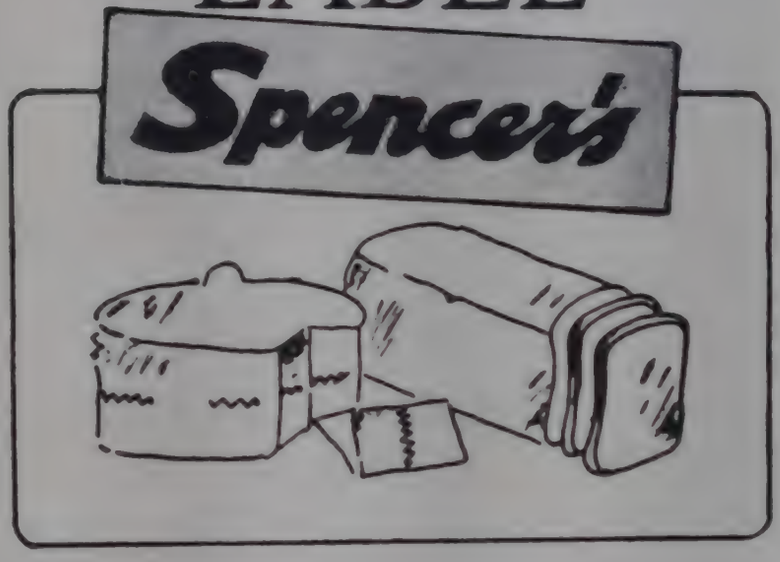

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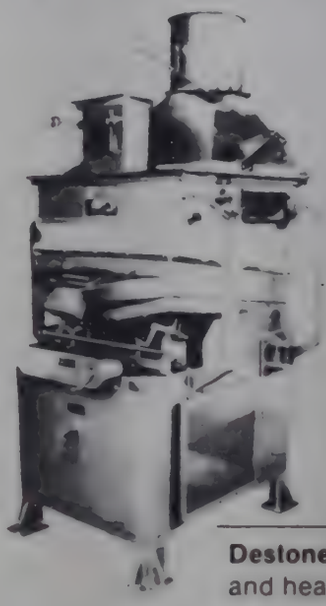

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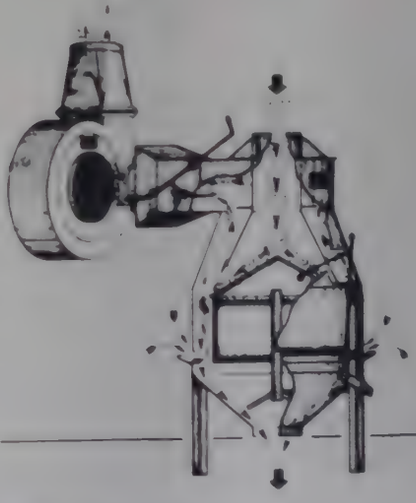

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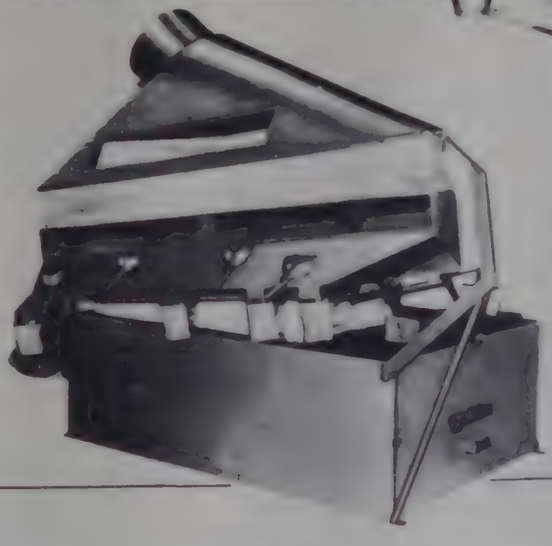

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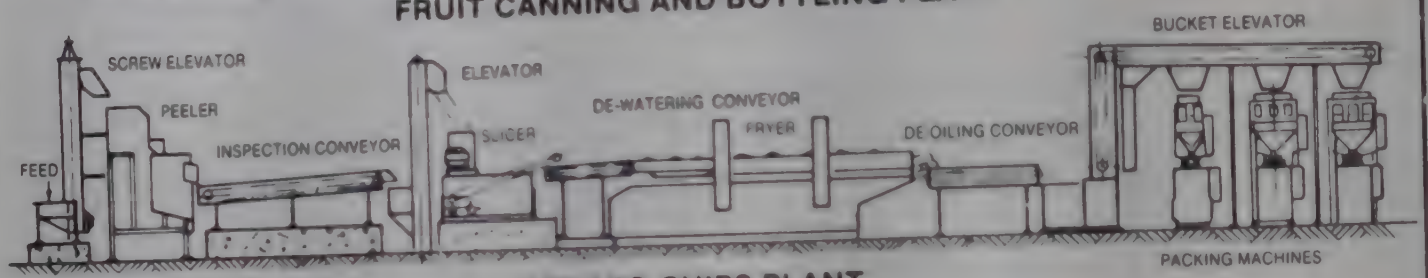

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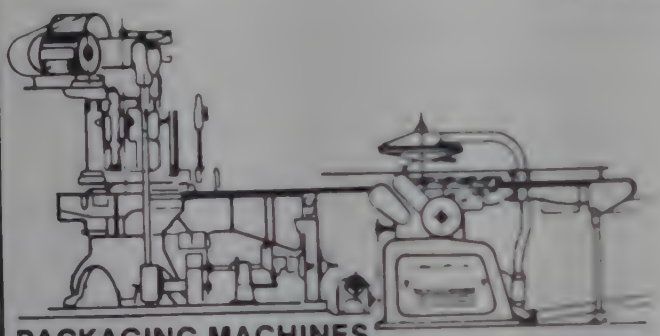

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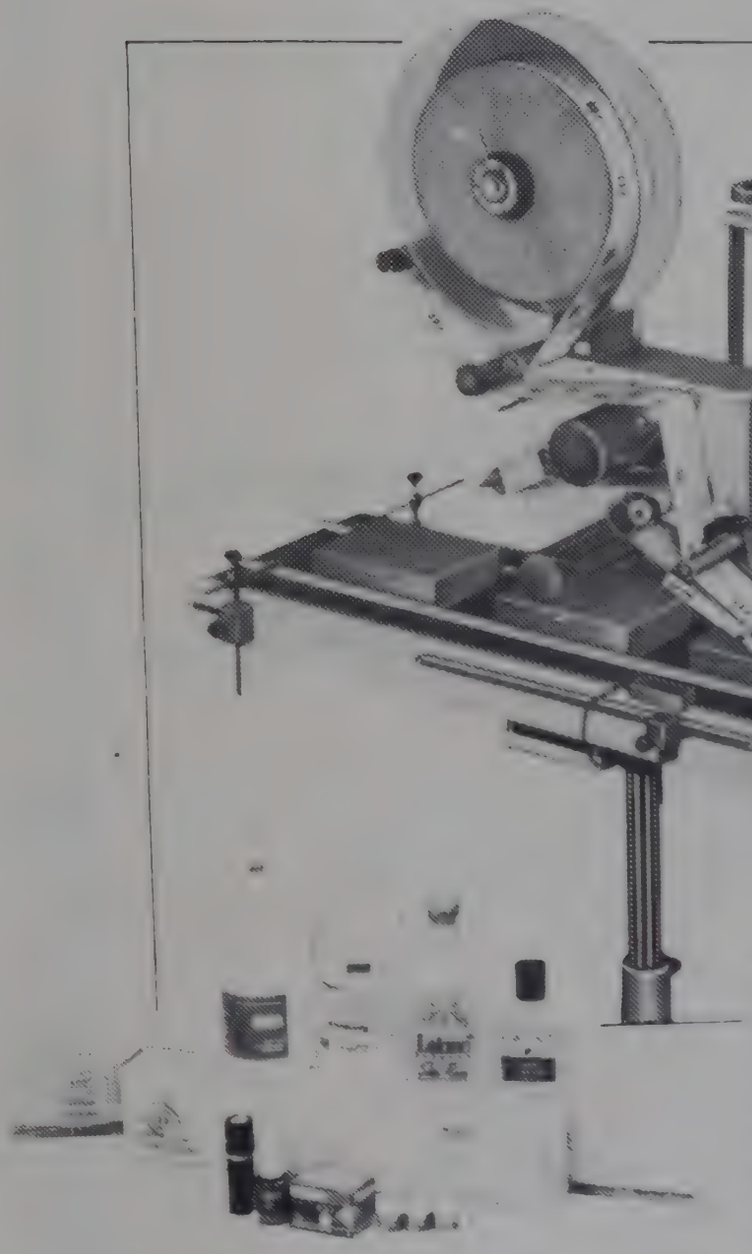

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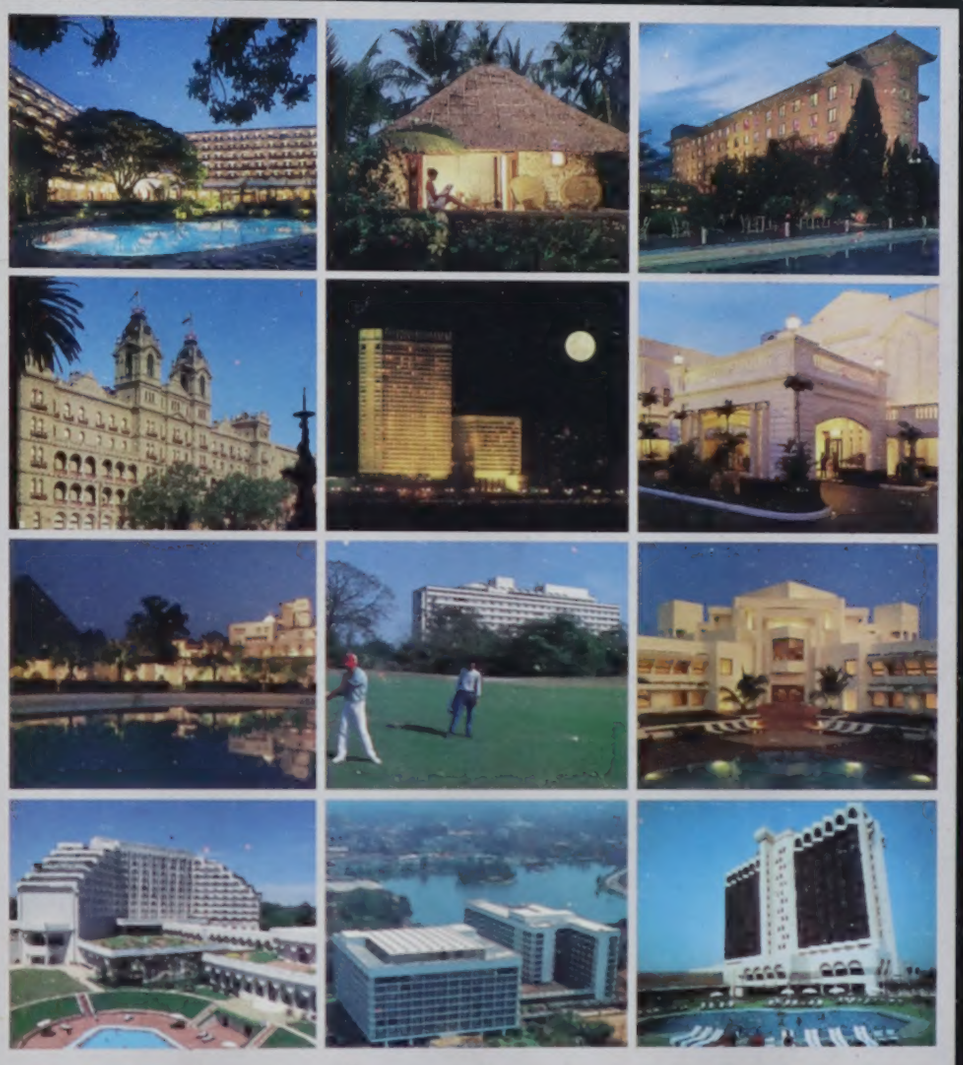

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